Formulations

The present invention relates to formulations for topical applications comprising pigments obtainable by agitating a suspension comprising one or more inorganic pigments and silver oxide, in order to reduce undesirable side effects caused by microorganisms.

Microbial contamination is an essential concern in our daily life and has a great impact for products and formulations. The usage of preservatives is a common method for preventing microbial contamination. However, the current trends show that organic preservatives are not well seen as such in view of regulatory affairs. Therefore, there is a real need of new harmless and compatible anti-microbial substances.

Products used in our daily life normally have a broad variety of features. Special effects of the products are for example often combined with colour such as in cosmetics, plastics, paints etc. Each feature has to be introduced into the product by a separated compound or material. This complicates the production process and especially in the case of cosmetic or pharmaceutical products this can result in restrictions for the allowance of compositions. It is therefore useful to combine several features in one component of the composition. One basic feature is colour, in fact nearly all products of our daily life are coloured.

EP 0 665 004 discloses antimicrobial cosmetic pigments comprising inorganic cosmetic pigments, an amorphous glassy coating layer of metal oxide formed over the surface of said inorganic cosmetic pigment and antimicrobial metals or antimicrobial metal ions intercalated inside the lattice of said coating layer of metal oxides. The objective of EP 0 665 004 is to provide a cosmetic composition containing no preservatives and thereby having no fear of dermal irritation from conventional preservatives

and is therefore directed only to the prevention of microbial contamination of the cosmetic composition.

The prevention of progeny of germs in formulations is not the sole problem of contamination with microorganisms. Especially on the human skin microorganisms are numerously represented. On the healthy skin the number and the species of microorganisms are balanced, that means no medical conditions can be observed. But if the number of certain species increases or infectious microorganisms colonize the skin, undesirable side effects are generally the consequence. Such side effects can be the appearance of, for example, dandruffs or malodor. It is an object of the present invention to find formulations that help to reduce such side effects. Additionally, it is desirable that the contamination with microorganisms of the formulations themselves or mixtures of the formulations with other ingredients is reduced.

Surprisingly, it has been found that formulations according to the present invention can fulfil the objectives cited above. Therefore, the present invention describes formulations for topical applications comprising pigments obtainable by agitating a suspension comprising one or more inorganic pigments and silver oxide, in order to reduce undesirable side effects caused by microorganisms. Preferably, the formulations are cosmetic formulations.

Formulations of the present invention help to reduce undesirable side effects of the progeny of microorganisms on the skin. Therefore, the inventive formulations can be used for example for the prophylaxis and/or treatment of acne, malodor or dandruffs without the necessary addition of further antimicrobial compounds. Additionally, contamination with microorganisms of the formulations according to the present invention or mixtures of the formulations with other ingredients can be reduced. Furthermore, formulations according to the present invention comprise

pigments that combine the antimicrobial activity with the properties of the pigments, such as, depending on the pigments used, broad variety of colours or even transparency, tinting strength, hiding power, interference effects or lustre. For example in the case of fillers as basis materials for the inorganic pigments used in formulations according to the present invention, the skin feeling remain unaltered during the manufacturing process. The combination of features as described above eases the manufacturing of formulations because the amount of preservatives, which has to be added to the formulation, can be reduced. If desired, the colour of the employed inorganic pigment used in formulations according to the present invention does not show a visually noticeable difference compared to the original inorganic pigment. Furthermore, formulations according to the present invention show good application behaviour, such as skin feeling.

Important constituents of the formulations according to the present invention are the pigments obtainable by agitating a suspension comprising one or more inorganic pigments and silver oxide. The inorganic pigments can have any known regular or irregular shape, for example the shape of platelets, spheres or needles. Preferably the pigments are platelet-shaped or spherical.

Inorganic pigments in this sense comprise (according to DIN 55944) inorganic white pigments, inorganic coloured pigments, inorganic black pigments such as for example Carbon Black, effect pigments and luminous pigments, but also magnesium carbonate, mica, SiO_2, TiO_2, aluminium oxide, glass, micaceous iron oxide, oxidised graphite, aluminium oxide-coated graphite, basic lead carbonate, barium sulphate, chromium oxide or MgO can be used in the present invention.

Preferably used are pigments selected from the group of effect pigments. Examples of effect pigments are those based on substrates which can additionally be coated with one or more layers of BiOCl and/or transparent,

semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials. The substrate for the effect pigments is preferably platelet-shaped and is preferably selected from the group of natural or synthetic mica, SiO_2, TiO_2, BiOCl, aluminium oxide, glass, micaceous iron oxide, graphite, oxidised graphite, aluminium oxide-coated graphite, basic lead carbonate, barium sulphate, chromium oxide, BN, MgO, magnesium fluoride, Si_3N_4 and/or metal. Examples for metals are aluminium, titanium, silver, copper, bronze, alloys or gold, preferably aluminium or titanium. The metals can be passivated by inorganic treatment. Effect pigments with natural or synthetic mica, SiO_2, TiO_2, iron oxide, BiOCl, aluminium oxide and/or glass are especially preferred as substrates.

For the one or more layers of transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials all known materials can be selected. The one or more layers of transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials can have a high refractive index ($n > 1.8$) or a low refractive index ($n \leq 1.8$). The metal oxides or metal oxide hydrates can be selected from any known metal oxide or metal oxide hydrate, such as for example SiO_2, Al_2O_3, TiO_2, ZnO, ZrO_2, Ce_2O_3, FeO, Fe_2O_3, Cr_2O_3, SnO_2, silicon oxide hydrate, aluminium oxide hydrate, titanium oxide hydrate and/or mixtures thereof, such as for example ilmenite or pseudobrookite. The metal can be selected from any known metal, such as for example chromium, molybdenum, aluminium, silver, platinum, nickel, copper, gold and/or alloys, preferably from aluminium and/or silver. An example for a metal fluoride is magnesium fluoride. As metal nitrides or metal oxynitrides for example the

nitrides or oxynitrides of titanium, zirconium and/or tantalum can be used. Preferably the one or more layer consist of metal oxides, metal oxide hydrates, metals and/or metal fluorides, in particular metal oxides and metal oxide hydrates. Furthermore, the effect pigments can have multilayer compositions comprising materials with a high and a low refractive index. formulations according to the present invention comprising inorganic pigments based on multilayer effect pigments are characterised through an intensively lustrous appearance and an angle-dependent interference colour. Preferably the one or more layers of BiOCl and/or transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials are arranged as alternating layers of transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials or BiOCl with a refractive index $n > 1.8$ and transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials with a refractive index $n \leq 1.8$, in particular as stack of two layers comprising one layer of a material with a high refractive index and one layer of a material with a low refractive index, whereas one or more of these stacks can be applied to the substrate. The sequence of the layers of the material with a high refractive and the material with the low refractive index can be adapted to the material of the substrate thus incorporating the substrate into the multilayer composition.

Preferred examples for materials with a refractive index $n > 1.8$ are titanium oxide, iron oxide, iron titanate, iron, chromium, silver and/or nickel, preferably titanium oxide, iron oxide, iron titanate. Preferred examples for materials with a refractive index $n \leq 1.8$ are silicon oxide, silicon oxide hydrate, aluminium oxide, aluminium oxide hydrate, aluminium and/or

magnesium fluoride. In another embodiment the transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials additionally may contain organic and/or inorganic colorants or elements as dopant. The absorption colour of the organic or inorganic colorant is combined with interference effects of the one or more layers of metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials thus producing pigments with special colour effects. Examples of organic colorants are azopigments, anthrachinonepigments, indigo- or thioindigo derivatives, diketo-pyrrolo-pyrrol pigments, perylen pigments or phthalocyanin pigments. Carbon black, Prussian blue, Turnbulls blue, Rinnmanns green, Thenards Blue and coloured metal oxide are only few examples of inorganic colorants, which can be introduced into the one or more layers. Yttrium or antimony can be used as dopant. Combinations of the materials mentioned above, for example mica platelets coated with fine particles of barium sulphate and a thin film of titanium dioxide are within the scope of the present invention. Pigments based on all these systems combine the absorption and interference colour of the pigments with an antimicrobial activity thus enhancing the applicability of the pigments in order to reduce undesirable side-effects caused by microorganisms, such as for example acne, dandruffs or maolodour. Furthermore, usage of these pigments can result in the reduction of the content of preservatives added to formulations, thus enabling the reduction of production costs and efforts necessary by the applicant to prevent the formulations and applications to be contaminated with microorganisms.

The outer layer of the effect pigments which can be used according to the present invention preferably comprises a transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxide, metal suboxide, metal oxide hydrate and/or mixture of these

materials, most preferably a metal oxide or metal suboxide with a high refractive index. This outer layer can be additionally applied to the one or more layers or can be one of them. Preferably the outer layer is composed of TiO_2, titanium suboxides, Fe_2O_3, SnO_2, ZnO, ZrO_2, Ce_2O_3, CoO, Co_3O_4, V_2O_5, Cr_2O_3 and/or mixtures thereof, such as for example ilmenite or pseudobrookite, TiO_2 is in particular preferred.

Examples and embodiments of the above-mentioned materials and pigment compositions are for example described in Research Disclosure RD 471001 and RD 472005, whose specifications are herein incorporated by reference.

The mean diameter of platelet-shaped substrates and hence the resulting pigments can vary between 1 and 200 µm, preferably 10 and 150 µm. Depending on the desired application, the size of the pigments can accordingly optimised. The overall thickness of the pigments is in the range between 0.05 and 6 µm, in particular between 0.1 and 4.5 µm.

The thickness of the one or more layers of transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials can vary between 3 and 300 nm, preferably between 20 and 200 nm. The thickness of the metal layers is preferably in the range of 4 to 50 nm. By adjusting the layer thickness the intensity of the absorption colour or the interference colours and angles can be tuned.

Depending on the material of the substrate and the thereon-coated layers, inorganic pigments with variable colour, hiding strength, lustre and angle-dependent colour impressions (optically variable pigments) are obtainable.

The preparation of above described layers can result from wet chemical treatment, from sol gel processes or by chemical or physical vapour deposition (CVD/PVD). After deposition, the resulting pigments can be dried or calcined.

Examples of effect pigments described here comprise pigments like Iriodin®, Candurin®, Timiron®, Colorstream® and Xirallic® pigments from Merck KGaA, Mearlin® and Dynacolor® pigments from Engelhard Corp., Variochrom® and Paliochrom® pigments from BASF or Spectraflair® pigments from Flex Products.

In another preferred embodiment of the present invention the inorganic pigments comprise spherical particles of metal oxides, for example SiO_2, TiO_2, aluminium oxide, glass, MgO, iron oxide but also BiOCl, magnesium carbonate, graphite, oxidised graphite, aluminium oxide-coated graphite, basic lead carbonate, barium sulphate, chromium oxide, BN, magnesium fluoride, Si_3N_4 and/or metals. Preferably the spherical particles comprise SiO_2, TiO_2, Al_2O_3, ZnO, Fe_2O_3, FeO and/or mixtures thereof. Furthermore, the spherical particles can be coated with one or more layers of transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials. The materials for the one or more layers of transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials can be selected from the ones described for the effect pigments.

Spherical capsules of materials described above encapsulating organic and/or inorganic compounds or materials are also suited in the sense of the definition of inorganic pigments applied here. The encapsulated compound

or material can for example be selected for example from UV-filters. Capsules, which are to be used particularly preferably, have walls that can be obtained by a process for example described in the applications WO 00/09652, WO 00/72806 and WO 00/71084. Preference is given here to capsules whose walls are made of silica gel.

In one embodiment of the present invention the spherical particles are coated with one or more layers of transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates, metals, metal nitrides, metal oxynitrides, metal fluorides and/or mixtures of these materials. Layers of transparent, semitransparent or opaque, selectively or nonselectively absorbing or nonabsorbing metal oxides, metal suboxides, metal oxide hydrates as an outer layer, are preferred. Particles described above can be obtained commercially, e.g. as Ronaspheres® or Eusolex®UV-Pearls™ from Merck KGaA, Darmstadt. These pigments are advantageous in or pharmaceutical formulations related to their spherical shape. formulations comprising these pigments show, depending on the material used, good wrinkle hiding effects and a good skin feeling. The pigments can have the function of an filler or in the case of the capsules as well as of an active ingredient with combined features such as antimicrobial activity and for example UV-filtering activity. Furthermore, formulations comprising pigments based on these substrates also reduce the gloss of the skin and give to the skin surface a smoother appearance. In addition, the skin feeling is improved, because of the glide and roll effect of the spheres.

The mean diameter of the spherical particles or capsules can vary between 5 nm and 100 µm, preferably between 8 nm and 50 µm and most preferably from 8 nm to 5 µm. Spherical metal oxides, in particular metal oxides with UV-filtering activity, preferably have a mean diameter of 5 to 100 nm, especially of 8 to 50 nm and most preferably of 8 to 30 nm. A large surface area characterizes these particles, which therefore can

advantageously be used as inorganic pigments for formulations according to the present invention. The antimicrobial activity is combined with for example the UV-filtering activity, thus providing multifunctional materials.

In a further embodiment, the inorganic pigments can additionally be further coated with a protective coating layer. The protective coating layer is believed to influence the rate at which the antimicrobial component diffuses from a dispersed particle into the application matrix. The small residual porosity of the silica or alumina coating, for example, also allows the antimicrobial component to diffuse through at a slow controlled rate thus extending the duration of the antimicrobial activity. Further, the ability to adjust the dispersibility of the particulate compositions of this invention both increases their use efficiency and improves the quality of the product. The antimicrobial particles may further comprise a tertiary coating layer of a hydrous metal oxide, which is much legs agglomerated and disperse readily in polymers. For example, a tertiary coating of hydrous alumina or magnesia will raise the isoelectric point of the composition. The control of the isoelectric point between about 5.5 and about 9.5 is beneficial in facilitating the dispersion and/or flocculation at the particulate compositions during plant processing and in their end use applications. This both increases the use efficiency of the antimicrobial pigments and improves the quality in applications. Enhanced dispersibility also can be impacted by micronizing the product with small levels, e.g. 0.1 to 1 % of organic dispersion aids. Dispersion aids may be incorporated either with the antimicrobial pigments or in the process for incorporating them in applications.

The protective coating is selected from silica, silicates, borosilicates, aluminosilicates, alumina, aluminum phosphate, or mixtures thereof. The protective coating functions as a barrier between the antimicrobial outer layer and an application matrix in which it may be incorporated, minimizing interaction with the application matrix. This protective coating also is

believed to influence the rate at which the antimicrobial component diffuses from a dispersed pigment into the application matrix.

The protective protective coating layer corresponds to 0.5 to 20 % by weight based on the antimicrobial pigments, and preferably, e.g., 1 to 5 % by weight of silica or e.g., 1 to 6 % by weight of alumina in the coated antimicrobial pigment. It will be appreciated by those skilled in the art that if fine particles of a substrate are employed in carrying out the invention, the practitioner should assure total surface coverage of the first coated substrate. The protective layer of silica or alumina can be quite dense although it must be sufficiently porous to permit diffusion of the antimicrobial metal ions through the coating at a slow rate, while functioning as a barrier which limits interaction between the antimicrobial layer and the application matrix in which it is distributed. Silica is a preferred coating material because of the relative ease with which dense, uniform coatings can be obtained. Silica-coated particles my have a low isoelectric point and may tend to be difficult to disperse in organic materials. The isoelectric point represents the pH at which a particle surface carries zero electric charge. Control of the isoelectric point between 5.5 and 9.5 is beneficial in facilitating the dispersion and/or flocculation of the particulate compositions during plant processing and in their end use applications. Therefore, for particles coated with silica or related materials with a low isoelectric point, a tertiary coating of hydrous alumina or magnesia or other metal oxide may be added to raise the isoelectric point. For example, hydrous oxides of Al, Mg, Zr and the rare earths, may bring the isoelectric point into the range of 5.5 to 9.5. Hydrous alumina, typically as a mixture of boehmite (AlOOH) and amorphous alumina ($Al_2O_3H_2O$), is a preferred tertiary coating material. Isoelectric points in a preferred range of 5.5 to 8.8 can readily be obtained with alumina coatings. For higher isoelectric points, magnesia is preferred. Dispersion aids may be incorporated either with the antimicrobial pigments or in the process for

incorporating them in applications to facilitate dispersion in end use applications.

In an alternative embodiment of the invention, alumina may be selected as the protective coating and a further coating may not be needed to adjust the isoelectric point. When alumina is used as the protective coating, the isoelectric point of the resulting pigment typically will be in the preferred range.

The pigments included in formulations according to the present invention can be obtained in a simple way. A preferred process for the production of the pigments includes the agitation of a suspension comprising one or more inorganic pigments and silver oxide as antimicrobial component. The process is based on a process described by A. Goetz, E. C. Y. Inn in "*Reversible Photolysis of Ag Sorbed on Collodial Metal Oxides*" in *Rev. Modern Phys.* **1948**, *20*, 131-142.
The preparation can be performed in water, ethanol, methanol, 1-propanol, 2-propanol and/or mixtures thereof, preferably water is used. The preparation temperature can vary between 10 and 60°C, preferably between 20 and 45°C and is most preferably held at 37°C.

The suspension is agitated from 4 up to 24 hours, preferably from 8 to 20 hours, and most preferably from 10 to 18 hours.

The progress of the reaction can be easily controlled. The initial dark colour of the reaction mixture, which depends on the concentration of silver oxide, turns to colourless at the end of the reaction. Similar pigments with antimicrobial activity can be obtained by substituting silver oxide by other antimicrobial compounds, such as for example silver salts, for example silver halogenide, silver nitrate, silver sulfate, silver carboxylates such as silver acetate, silver benzoate, silver carbonate, silver citrate, silver lactate,

silver salicylate, but also copper oxides, copper sulfide, copper nitrate, copper carbonate, copper sulftate, copper halogenides, copper carboxylates, zinc oxide, zinc sulfide, zinc silicate, zinc acetate, zinc chloride, zinc nitrate, zinc sulfate, zinc gluconate, zinc citrate, zinc phosphate, zinc propionate, zinc salicylate, zinc lactate, zinc oxalate, zinc iodate, zinc iodide or combinations thereof. Silver oxide, silver acetate copper sulfate, zinc acetate are the most preferably used.

The amount of the antimicrobial compound is in the range of 0.001 to 10% by weight, preferably 0.005 to 5% by weight and most preferably 0.01 to 0.5% by weight, based on the inorganic pigment.

The resulting pigments with antimicrobial activity can be separated using any method known for a person skilled in the art. Preferably the product is filtrated or filtrated with suction and washed with water. Additionally the silver treated pigments can be further washed with organic solvents, such as acetone, to remove residual water. The pigments according to the present invention can be dried. Preferably the antimicrobial pigments are dried in an oven, most preferably at a temperature below 50°C, or by using a vacuum pump or a continuous flash evaporator, most preferably by evaporation of the solvents in vacuum.

The production process described can be performed easily and adds an antimicrobial activity to the features of the introduced inorganic pigment, such as colour, transparency, lustre or interference. All compounds needed are readily available and can be easily handled. The process can be performed directly following the production process of the pigments without technical expense.

It is believed that pigments are formed via an ion exchange reaction between protons or ions and antimicrobial ions of the antimicrobial compounds, such as for example silver ions, resulting in silver ions bonded

to moieties of the inorganic pigment, for example Si-O$^-$ or Ti-O$^-$ moieties. These oligodynamically active structures can approximately be described as silver silicates or silver titanates. The source of silver ions for the reaction is for example silver oxide, which is only slightly soluble in water. However, the few silver ions that are at any time present in solution are capable of replacing protons on the surface area of the inorganic pigments forming water as the only reaction product besides the antimicrobial pigments. During the course of investigation further analytical experiments revealed the absence of silver metal or silver oxide simply deposited on the surface encouraging silver silicate or silver titanate to be the most relevant structures.

In a further embodiment the inorganic pigments are further coated with a protective coating layer. Usable materials for the protective coating layer are mentioned above. Any method known for a person skilled in the art can be used to coat the pigments with the protective coating layer, preferably the coating is performed wet-chemically. In the case of a silica coating, active silica is added to the agitated aqueous suspension heated to a temperature between 60 and 90°C, while maintaining the pH of the suspension in the range of 6 to 11. The procedure is described in detail in U.S. Pat. No. 2,885,366, the teachings of which are incorporated herein by reference. Active silica, a low molecular weight form of silica, such as silicic acid or polysilicic acid, may be added to the suspension, or formed in situ as by the continuous reaction of an acid with an alkali silicate. Potassium silicate is generally preferred since the potassium ion has little tendency to coagulate active silica. The bulk commodity is also more stable, which is advantageous from the standpoint of shipping and storing. The silica content of the coated composition is between 0.5 and 20 % by weight and most commonly it is between 1 and 5 % by weight.

During the silica deposition it is desirable to maintain substantially uniform conditions in the reaction zone to minimize precipitation of free silica gel.

This is preferably accomplished by maintaining good agitation and introducing the reactants in a manner that does not allow local over-concentration. The pH is allowed to fall gradually to about 6 as the process is completed and the slurry is then cured to permit completion of the deposition of silica onto the surface of the antimicrobial pigments. The curing step consists of holding the slurry at temperatures between 60 and 90°C, preferably between 75 and 90°C, for from about one-half to two hours, preferably about one hour, while maintaining the pH of the agitated slurry between 6 and 7.5.

Alternatively, the pigments may be coated with alumina. This is accomplished by the addition, to the agitated aqueous suspension of the antimicrobial particles heated to between 60 and 90°C, of an alkali aluminate solution or other soluble aluminum salt, e.g., aluminate nitrate while maintaining the pH in the range 6 to 11 by the concurrent addition of acid or base, as required. Sodium aluminate is preferred, because it is commercially available as a solution, such as Vining's Solution. It is desirable to increase the density of the amorphous alumina phase in the coating by the addition of polyvalent anions selected from the group consisting of sulfate, phosphate and citrate. As in the case of the silica coating a small residual porosity is necessary to allow the antimicrobial species to diffuse through the protective coating. The alumina content of the coated composition is between 0.5 and 20 % by weight and preferably between 1 and 6 % by weight. The concentration of polyvalent anion in the suspension is about 0.5 % by weight based on the alumina used to coat the particles.

The product is then recovered as a dry powder, consisting of antimicrobial pigments coated with silica, alumina or silica/alumina, by filtration or centrifugation combined with aqueous washing to remove soluble salts. A vacuum rotary-type filter is particularly suitable since washing can be carried out without removing the product from the filter. The thus obtained

pigments can be introduced in formulations for topical applications. To accomplish this, any method known to a person skilled in the art can be used.

Preferably, a process for the preparation of formulations according to the present invention comprises the steps

a) agitating a suspension comprising one or more inorganic pigments and silver oxide and
b) mixing the pigment a) with further ingredients suitable for formulations.

One major advantage of formulations according to the present invention is, that they can be used for the inhibition of the growth and progeny of microorganisms. Microorganisms in the latter sense are for example bacteria (gram positive and gram-negative bacteria), yeasts, fungi and viruses. Examples of microorganisms described herein are microorganisms selected from for example Staphylococci, Micrococci, Escherichia, Pseudomonas, Bacilli, Salmonella, Shigella, Porphyromonas, Prevotella, Wolinella, Campylobacter, Propionibacterium, Streptococci, Corynebacterium, Treponema, Fusobacterium, Bifidobacterium, Lactobacillus, Actinomyces, Candida, Malazessia, Aspergillus, herpes simplex 1 and 2.

Formulations according to the present invention and the therein used antimicrobial pigments show a good microbicidal activity, that means the number of germs in the formulation and on the skin can be reproducibly decreased. In particular the number of bacteria can be decreased by at least a factor 10^3 over a time period of 14 days (starting with an inokulum of 10^5-10^6 bacteria/g/ml). In particular, the number of yeasts and fungi can be decreased by at least a factor 10 over a time period of 14 days (starting with an inokulum of 10^5-10^6 fungi or yeasts/g/ml).

The antimicrobial activity of the pigments in formulations according to the present invention can be shown by tests known for a person skilled in the art, for example those based on DIN 58940 and 58944.

Furthermore, formulations according to the present invention are advantageous with respect to therein used antimicrobial pigments, because they combine different properties of the basis materials with an antimicrobial activity, for example the combination of colour and antimicrobial activity. Depending on the concentrations of the antimicrobial compound reacted with the basis materials, variations of the colour are also possible. In the case of high concentrations of the antimicrobial compound differences with respect of the colour can be observed. In some case this is desirable to modify the colour to some extent. Preferably, the colour of the employed inorganic pigment and the antimicrobial pigment does not show a visually noticeable difference. Employed inorganic pigments means all above described pigments, which can be treated with for example silver oxide. One physical parameter for the verification of the latter observation is according to the Hunter model the comparison of the L, a and b values for the employed inorganic pigments and the antimicrobial pigments. The L value is for lightness, the a value is for redness-greenness and the b value is for yellowish-bluish. The a scale has a positive or negative value. Where the a value is positive, the perceived colour is reddish. Where the a value is negative, the perceived colour is greenish. Thus, the more positive the number, the more red the product. The more negative the number, the more greener the product. Similar is true for the b measurement. Where the b value is positive, the perceived colour is yellowish. Where the b value is negative, the perceived colour is bluish. Lightness L is measured on a scale of 0-100 where 0 is black and 100 is white. The L, a and b values of the employed inorganic pigments and the antimicrobial pigments have preferably a maximum deviation for the L value of $-6 \leq \Delta L \leq 6$, preferably of $-5 \leq \Delta L \leq 5$ and most preferably of $-4 \leq \Delta L \leq 4$, for the a value of $-5 \leq \Delta a \leq 5$

and most preferably of $-3 \leq \Delta a \leq 3$ and for the b value of $-5 \leq \Delta b \leq 5$, most preferably of $-3 \leq \Delta b \leq 3$.

Besides the colour and antimicrobial activity of the formulations comprising pigments descibed above they also show, depending on the pigment, good application behaviour such as dispersibility, a wrinkle-hiding effect, good skin feeling or a good chemical stability. In formulations according to the present invention these advantageous properties of the used inorganic pigments can also predominantly and unaltered be found, thus providing formulations comprising multifunctional pigments showing for example colour, good application behaviour combined with antimicrobial activity.

Formulations according to the present invention can be in the form of soaps, cleansers, solutions, suspensions, emulsions, pasta, ointments, gels, creams, lotions, powders, oils, pencils, deodorant-cremes, gels, lotions, deodorant sticks, Roll-ons, sprays and pump sprays or lacquers, such as nail laquers. In the case of nail laquers comprising antimicrobial pigments according to the present invention they can be used as well for aspects as well as for the treatment or prevention of nail mycosis. The combination of the colour effect with the antimicrobial activity is therefore advantageous. For example, formulations according to the present invention are stable and can be stored over a long period of time, thus facilitating the storage and consumption of these mixtures and preparations for the user. In particular in the case of water-based formulations, the antimicrobial activity is of great importance due to rapid fouling and contamination with bacteria of materials in these application areas. The amount of the pigments in the formulations is not crucial per se and can be adapted in each case to obtain the most effective result. Depending on the formulation the content preferably lies in the range of 0.1 to 70% per weight, based on the formulation.

In all above-mentioned formulations the pigments having antimicrobial activity can advantageously be combined with all known preservatives or antimicrobial agents, such as for example phenoxyethanol, triclosan, 7-ethylbicyclooxazolidine, benzoic acid, bronopol, butylparaben, chlorphenesin, diazolidinyl urea, dichlorobenzyl alcohol, dimethyl oxazolidine, DMDM hydantoin, ethylparaben, hexamidine diisethionate, imidiazolidinyl urea, imidiazolidinyl urea NF, iodopropynyl butylcarbamate, isobutylparaben, methylparaben, potassium sorbate NF FCC, propylparaben, quaternium-15, sodium benzoate NF FCC, sodium caprylate, sodium dehydroacetate, sodium dehydroacetate FCC, sodium hydroymethylglycinate, sodium hydroxymethylglycinate, sodium methylparaben, sodium propylparaben, sorbic acid NF FCC, anisic acid, benzethonium chloride, caprylic/capric glycerides, caprylyl glycol, di-alpha-tocopherol, ethylhexylglycerin, glyceryl caprate, methyl isothiazolinone, polymethoxy bicyclic oxazolidine. Tocopheryl acetate, alcohol, benzalkonium chloride, benzethonium chloride, camellia sinensis leaf extract, candida bombicola/glucose/methyl rapeseedate, hydrogen peroxide, methylbenzethonium chloride phenol, pinus pinaster bark extract, Poloxamer 188, PVP-Iodine, Rosmarinus officinalis Leaf extract, Vitis vinifera seed extract, ammomium benzoate, ammonium propioante, 5-Bromo-5-nitro-1,3-dioxane, Chloroxylenol, Ethyl alcohol, Glutaral, Iodopropynyl butylcarabamate, Isothiazolinone, Parabens, Pircotone olamine, Selenium disulphine, Sorbic acid (mold), Zinc pyrithione, Benzalkonium chloride, Benzethonium chloride, Benzoic acid, Dehydroacetic acid, Dimethyl hydroxmethyl pyrazole, Formaldehyde, Hexetidine, Mthyldibromo glutaronitrile, Salicylic acid, Sodium hydroxymethylglycinate, Sodium iodate, Zinc oxide, Benzyl alcohol (mould), Boric acid (yeast), Chloroacetamide, Phenoxythanol, Ortholphenylphenol, Benzalkonium chloride, Benzethonium chloride, 5-Bromo-5-nitro-1,3-dioxane, Bronopol, Diazolidinyl urea, Dimethyl hydroxmethyl pyrazole, Dimethyl oxazolidine, DMDM hydantoin, Ethyl alcohol, 7-Ethyl bicycloxazolidine, Formaldehyde, Glutaral, Imidazolidinyl urea,

Isothiazolinone, Methenammonium chloride, Methylbromo glutaronitrile, Parabens, Polymethoxy bicylooxazolidine, Quaternium-15, Sodium hydroxymethylglycinate, Thimersal, Benzoic acid, Benzyl alcohol, Chlorhexidine, Hexetidine, Phenethyl alcohol, Polyaminopropyl biguanide, Polyquarternium-42, Salicylic acid, Sodium iodate, Triclocarban, Triclosan, Zinc phenolsulphonate,Chloroacetamide, Chlorobutanol,Dehydroacetic acid, Neem seed oil, Parabens, Phenoxyethanol, Tee trea oil, Usnic acid, Ammonim Benzoate, Ammonium Propionate, Benziosthiazolinone, Benzoic Acid, Benzotriazole, Benzyl Alcohol, Benzylhemiformal, Benylparaben, 5-Bromo-5-Nitro-1,3-Dioxane, 2-Bromo-2-Notropropane-1,3-Diol, Butyl Benzoate, Butylparaben, Calcium Benzoate, Calcium Paraben, Calcium Propionate, Calcium Salicylate, Calcium Sorbate, Captan, Chloramine T, Chlorhexidine Diacetate, Chlorhexidine Digluconate, Chlorhexidine Dithydrochloride, Chloroacetamine, Chlorobutanol, p-Chloro-m-Cresol, Chlorophene, p-Chlorophenol, Chlorothymol, Chloroxylenol, Citrus Grandis (Grapefruit) Fruit Extract, Citrus Grandis (Grapefruit) Seed Extract, Copper Usnate, m-Cresol, o-Cresol, p-Cresol, DEDM Hydantoin, DEDM Hydantoin Dilaurate, Dehydroacetic Acid, Diazolidinyl Urea, Dibromopropamidine Diisethionate, Dimethyl Hydroxymethyl Pyrazole, Dimethylol Ethylene Thiourea, Dimethyl Oxazolidine, Dithiomethylbenzamide, DMDM Hydantoin, DMHF, Domiphen Bromide, Ethyl Ferulate, Ethylparaben, Ferulic Acid, Formaldehyde, Glutaral, Glycerol Formal, Glyoxal, Hexamidine, Hexamidine Diparaben, Hexamidine Paraben, 4-Hydroxybenzoic Acid, Hydroxymethyl Dioxazabicyclooctane, Imidazolidinyl Urea, Iodopropynyl Butylcarbamate, Isobutylparaben, Isodecylparaben, Isopropyl Cresols, Isopropylparaben, Isopropyl Sorbate, Magnesium Benzoate, Magnesium Propionate, Magnesium Salicylate, MDM Hydantoin, MEA-Benzoate, MEA o-Phenylphenate, MEA-Salicylate, Methylchloroisthiazolinone, Methyldibromo Glutaronitrile, Methylisothazolinone, Methylparaben, Mixed Cresols, Nisin, PEG-5 DEDM Hydantoin, PEG-15 DEDM Hydantoin, PEG-5 Hydantoin Oleate, PEG-15 DEDM Hydantoin Stearate, Phenethyl Alcohol, Phenol, Phenoxyethanol,

Phenoxyethylparaben, Phenoxyisopropanol, Phenyl Benzoate, Phenyl Mercuric Acetate, Phenyl Mercuric Benzoate, Phenyl Mercuric Borate, Phenyl Mercuric Bromide, Phenyl Mercuric Chloride, Phenylparaben, o-Phenylphenol, Polyaminopropyl Biguanide, Polyaminopropyl Biguanide Stearate, Polymethoxy Bicyclic Oxazolidine, Polyquaternium-42; Potassium Benzoate, Potassium Ethylparaben, Potassium Methylparaben, Potassium Paraben, Potassium Phenoxide, Potassium o-Phenylphenate, Potassium Propionate, Potassium Propylparaben, Potassium Salicylate, Potassium Sorbate, Propionic Acid, Propyl Benzoate, Propylparaben, Quaternium-8, Quaternium-14, Quaternium-15, Silver Borosilicate, Silver Magnesium Aluminium Phosphate, Sodium Benzoate, Sodium Butylparaben, Sodium p-Chloro-m-Cresol, Sodium Dehydroacetate, Sodium Ethylparaben, Sodium Formate, Sodium Hydroxymethane Sulfonate, Sodium Hydroxymethylglycinate, Sodium Isobutylparaben, Sodium Methylparaben, Sodium Paraben, Sodium Phenolsulfonate, Sodium Phenoxide, Sodium o-Phenylphenate, Sodium Propionate, Sodium Propylparaben, Sodium Pyrithione, Sodium Salicylate, Sodium Sorbate, Sorbic Acid, TEA-Sorbate, Thimerosal, Triclocarban, Triclosan, Undecylenoyl PEG-5 Paraben, Zinc Pyrithione or combinations thereof, such as for example Benzyl alcohol/mehtylchloroisothiazolinone/methylisothiazolinone, Benzyl alcohol/PPG-2 methyl ether/bronopol/deceth-8/iodopropynyl/butylcarbamate, Chloroacetamide sodium benzoate, Dehydroacetic acid/benzyl alcohol, Diazolidinyl urea/iodopropynyl butylcarbamate, Diazolidinyl urea/methylparaben/ethylparaben/butylparaben/propylparaben/isobutylparaben/2-phenoxyethanol, DMDM hydantoin/iodopropynyl butylcarbamate, Glycerin/water/ethoxdiglycol/caprylyl glycol/sodium polyacrylate, Glyceryl laurate/caprylyl/phenylpropanol/dipropylene glycol, Isopropylparaben/isobutylparaben/butylparaben, Methyl chloroisothiazolinone/methyl isothiazolinone, Methyldibromo glutaronitrile/methylchloroisothiazolinone/methylisothiazolinone/phenoxyethanol, Methyldibromo glutaronitrile/phenoxyethanol,

Methylchloroisothiazolinone/methylisothiazolinone, Methylparaben/ethylparaben/butylparaben/propylparaben/butylenes glycol, Methylparaben/ethylparaben/butylparaben/propylparaben/isobutylparaben, Methylparaben/ethylparaben/butylparaben/propylparaben/isobutylparaben/2-phenoxy-ethanol/bronopol, Methylparaben/ethylparaben/butylparaben/propylparaben/1,3-butylene glycol isomer, Methylparaben/propylparaben, Methylparaben/propylparaben/benzyl alcohol, Methylparaben/propylparaben/bronopol/phenoxyethanol, Methylparaben/propylparaben/bronopol/propylene glycol, Methylparaben/propylparaben/ethylparaben, Methylparaben/propylparaben/propylene glycol/diazolidinyl urea, Phenoxyethanol/benzoic acid/dehydroacetic acid, Phenoxyethanol/benzyl alcohol/potassium sorbate/tocopherol, Phenoxylethanol/chlorphenesin/glycerin/methylparaben/benzoic acid, Phenoxyethanol/DMDMhydantoin/Iodopropynyl butyl carbamate, Phenoxyethanol/DMDM hydantoin/methylparaben/propylparaben, Phenoxyethanol/isopropylparaben/isobutylparaben/butylparaben, Phenoxyethanol/methyldibromo glutaronitrile/idopropynyl butylcarbamate, Phenoxyethanol/methylparaben/butylparaben/ethylparaben/propylparaben, Phenoxyethanol/methylparaben/butylparaben/ethylparaben/propylparaben/isobutyl-paraben, Phenoxyethanol/methylparaben/isobutylparaben/butylparaben, Phenoxythanol/triethylene glycol/dichlorobenzyl alcohol, Polyaminopropyl biguanide/parabens/phenoxyethanol, PPG-2 methyl ether/sodium benzoate/potassium sorbate/iodopropynyl butylcarbamate, Propylene glycol/benzyl alcohol/methylchloroisothiazolinone/methylisothaizolinone, Propylene glycol/diazolidinyl urea/iodopropynyl butylcarbamate, Propylene glycol/diazolidinyl urea/methylparaben/propylparaben, Propylene glycol/MDMD hydantoin/methylparaben, Propylene glycol/MDMD hydantoin/methylparaben/propylparaben, Propylene glycol/lichen extract, Propylene glycol/phenoxyethanol/chlorphenesin/methylparaben, Sodium

levulinate/phenylpropanol combinations. The combination of antimicrobial pigments with preservatives or antimicrobial agents in formulations according to the present invention shown above helps to decrease the amount of the preservative or antimicrobial agent in formulations, which is advantageous with respect to the regulatory status and the compatibility with the skin.

Furthermore, in formulations according to the present invention the antimicrobial pigments can be advantageously combined with antibiotics. Antibiotics in this sense mean all known antibiotics, for example selected from the group of Beta-lactam, Vancomycin, Macrolides, Tetracyclines, Quinolones, Fluoroquinolones, Nitrated compounds (as for instance Nitroxoline, Tilboquinol or Nitrofurantoin), Aminoglycosides, Phenicols, Lincosamids, Synergistins, Fosfomycin, Fusidic acid, oxazolidinones, Rifamycins, Polymixynes, Gramicidins, Tyrocydine, Glycopeptides, Sulfonamides or Trimethoprims. formulation somprising combinations of antimicrobial pigments and antibiotics are advantageous with respect to the resistance of several microorganisms against certain antibiotics. A combination of antibiotics with antimicrobial pigments according to the present invention helps to overcome the resistance by simply decreasing the number of microorganisms which have not been affected by the antibiotics.

Generally, formulations according to the present invention can be used to reduce undesirable side-effects caused by microorganisms on the skin. Therefore, formulations for topical applications and/or pigments according to the present invention can be used for prophylaxis and/or treatment of acne, caused by microorganisms, such as *Propionibacterium acnes, Propionibacterium granulosum* or *Staphylococcus epidermidis*. *Propionibacterium acnes* are a normal inhabitant of the skin. It uses sebum as a nutrient for growth, therefore increases in follicles during puberty.

People with acne have more *Propionibacterium acnes* in their follicles than people without acne. The presence of bacteria attracts white blood cells to the follicle. These white blood cells produce an enzyme that damages the wall of the follicle, allowing the contents of the follicle to enter the dermis. This process causes an inflammatory response seen as red bumps, pustules and nodules. The bacteria also cause the formation of free fatty acids, which are irritants, increasing the inflammatory process in the follicle. Suitable formulations according to the present invention comprising antimicrobial pigments are in the form of soaps, cleansers, solutions, suspensions, emulsions, pasta, ointments, gels, creams, lotions, powders, oils, pencils, sprays. Further ingredients that can be incorporated into the formulations are described later in this application in more detail.

Furthermore, formulations according to the present invention can be in the form of deodorants pigmented with antimicrobial pigments. Therefore, formulations for topical applications and/or pigments can be used for the prophylaxis and/or treatment of malodor. Different forms of deodorants are in mind: deodorant-cremes, gels, lotions, emulsions, deodorant sticks, Roll-ons, sprays and pump sprays. The pigments are preferably combined with a suitable carrier material used in deodorants. Examples of suitable carrier materials are glyceryl stearate, aluminium chlorohydrate, propylene glycol, carbomer, glycerin, dicapryl ether, ethanol, glyceryl cocoate, cylomethicone, dimethicone, dipropylene glycol, stearyl alcohol, mineral oil, phenyltrimethicone or sodium stearate. The odour production of the skin is the result from the modifications of initially odourless secretions from the apocrine glands, such as for example lipids, proteins, ammonia, steroids and reducing sugars, by microorganisms, like for example *Staphylococcus*, *Corynebacterium* or *malassezia*. The formulations are effective against the Gram-positive cocci group, for example against the *Micrococcaceae* family (*Staphylococcus aureus, staphylococcus epidermidis, staphylococcus hominis*), against the Gram-positive rods, for example against the

Coryneforms family (*Brevibacterium* and /or *corynebacterium* for example) causing malodour of the skin, which can be reduced by deodorants comprising these pigments. The deodorants may comprise various adjuvants used in this type of composition, such as scents or perfumes, preservatives, electrolytes, silicone derivatives, dyes and/or pigments which colour the composition itself, or other ingredients customarily used for deodorants. Further ingredients that can be incorporated into the formulations are described later in this application in more detail.

Formulations for topical applications and/or pigments according to the present invention can also be used for prophylaxis and/or treatment of dandruff. Dandruff is a scalp disorder that is characterized by the formation of white or grey scales, accompanied by mild itching. The scales present diffusely and in patches. Dandruff occurs most frequently and most severely in young males, is rare in children and the elderly, and is otherwise common throughout the world's adult population. Dandruff has traditionally been linked to seborrhoea, an inflammatory skin disorder that is known for producing greasy scales superimposed upon reddened skin areas. However, seborrhoea can occur without dandruff, and dandruff can develop in the absence of apparent seborrhoea. Current knowledge suggests that the term "dandruff" is best used to describe the symptom complex of scalp flaking and itching, rather than as a synonym for seborrhoea, which is a specific disease entity. Although dandruff is a possible symptom of seborrhoea, it also can potentially result from scalp irritation caused by excessive sun exposure, airborne environmental substances, and hair products. Dandruff reflects a fundamental abnormality in the dead outer layer of skin ("the scalp") that covers the hairy top of the head. The involved skin cells lack the ability to properly adhere to one another. Consequently, clumps of cells separate from the scalp surface as scales. The shedding of these scales produces flakes of dandruff. A relationship between dandruff and a class of yeast called *malassezia furfur* and *malassezia globosa* has long been recognized. Bacteria and yeast are

ordinary occupants of the human scalp. However, in those individuals with dandruff, yeast is present in significantly greater numbers than would normally be expected. Many doctors and researchers believe that inflammation caused by an immune response to the yeast produces the dandruff condition. In this case, a suitable formulation is in the form of a shampoo or lotion for rinsing out, the formulation in question being applied before or after shampooing, before or after colouring or bleaching or before or after permanent waving. It is also possible to choose a formulation in the form of a lotion or gel for styling or treating the hair, in the form of a lotion or gel for brushing or blow-waving, in the form of a hair lacquer, permanent waving composition, colorant or bleach for the hair. The formulation may comprise various adjuvants used in this type of composition, such as surface-active agents, thickeners, polymers, softeners, preservatives, foam stabilizers, electrolytes, organic solvents, silicone derivatives, antigrease agents, dyes and/or pigments which colour the composition itself or the hair, or other ingredients customarily used for hair care. Further ingredients that can be incorporated into the formulations are described later in this application in more detail.

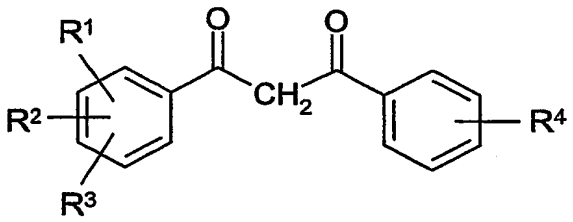
Preferably the formulation of the present invention may furthermore comprise at least one compound selected from the group consisting of suitable substrates for microorganisms, such as for example organic compounds. The suitable substrates for microorganisms are for example selected from the group consisting of alkanes, alkenes, alkines, with or without functional groups, sugars, polyols, alcohols, saturated or unsaturated carboxylic acids, proteins, amino acids, water, fatty acids, waxes, fats, mineral oils, salts, hormones, steroids, vitamins and/or derivatives or salts thereof. The combination of antimicrobial pigments with these substrates allows the broadening of the application area of these formulations. The contamination of formulations containing these substrates is no longer an obstacle for their use. Generally the use of antimicrobial pigments in formulations according to the present invention

allows the reduction of the amount or number of preservatives, which have to be added further to the formulation. In particular, there is no need for adding any further preservatives to the formulation.

Formulations according to the present invention usually comprise several ingredients. In the following examples of commonly used ingredients are given.

Preferred formulations additionally comprise at least one UV filter resulting in antimicrobial preparations having light protection properties. The UV filter can preferably be selected from the group of dibenzoylmethane derivatives. The dibenzoylmethane derivatives used within the scope of the present invention are products which are already well known per se and are described, in particular, in the specifications FR-A-2 326 405, FR-A-2 440 933 and EP-A-0 114 607.

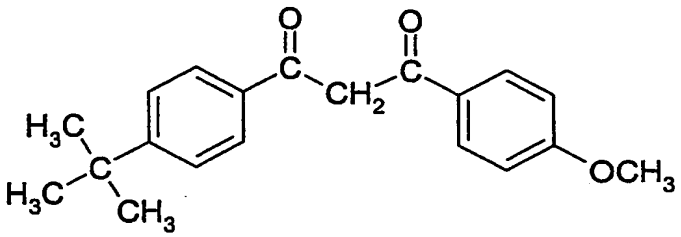
The dibenzoylmethane derivatives which can be used in accordance with the invention may be selected, in particular, from the dibenzoylmethane derivatives of the following formula:



in which R^1, R^2, R^3 and R^4, which are identical to or different from one another, are hydrogen, a straight-chain or branched C_{1-8}-alkyl group or a straight-chain or branched C_{1-8}-alkoxy group. In accordance with the present invention, it is of course possible to use one dibenzoylmethane derivative or a plurality of dibenzoylmethane derivatives. Of the dibenzoylmethane derivatives to which the present invention more

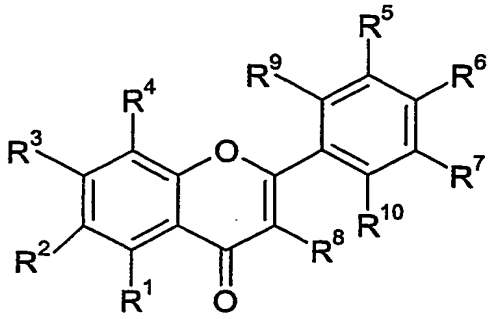
specifically relates, mention may be made, in particular, of: 2-methyldibenzoylmethane, 4-methyldibenzoylmethane, 4-isopropyldibenzoylmethane, 4-tert-butyldibenzoylmethane, 2,4-dimethyldibenzoylmethane, 2,5-dimethyldibenzoylmethane, 4,4'-diisopropyldibenzoylmethane, 4,4'-methoxy-tert-butyldibenzoylmethane, 2-methyl-5-isopropyl-4'-methoxydibenzoylmethane, 2-methyl-5-tert-butyl-4'-methoxydibenzoylmethane, 2,4-dimethyl-4'-methoxydibenzoylmethane and 2,6-dimethyl-4-tert-butyl-4'-methoxydibenzoylmethane, this list being non-restrictive.

Of the above-mentioned dibenzoylmethane derivatives, particular preference is given in accordance with the invention to 4,4'-methoxy-tert-butyldibenzoylmethane and especially 4,4'-methoxy-tert-butyldibenzoylmethane, which is commercially available under the trade name Eusolex® 9020 from Merck KGaA, where this filter conforms to the following structural formula:



A further dibenzoylmethane derivative which is preferred in accordance with the invention is 4-isopropyldibenzoylmethane.

Additionally, in likewise preferred embodiments of the invention, the preparations according to the invention may also contain compounds of the formula I which have a UV absorption in the UV-A and/or UV-B region:



I

where R^1 to R^{10} may be identical or different and are selected from

- H
- OR^{11}
- straight-chain or branched C_1- to C_{20}-alkyl groups,
- straight-chain or branched C_3- to C_{20}-alkenyl groups,
- straight-chain or branched C_1- to C_{20}-hydroxyalkyl groups, where the hydroxyl group may be bonded to a primary or secondary carbon atom of the chain and furthermore the alkyl chain may also be interrupted by oxygen, and/or
- C_3- to C_{10}-cycloalkyl groups and/or C_3- to C_{12}-cycloalkenyl groups, where the rings may each also be bridged by $-(CH_2)_n-$ groups, where n = 1 to 3,
- where all OR^{11} are, independently of one another,
  - OH
  - straight-chain or branched C_1- to C_{20}-alkoxy groups,
  - straight-chain or branched C_3- to C_{20}-alkenyloxy groups,
  - straight-chain or branched C_1- to C_{20}-hydroxyalkoxy groups, where the hydroxyl group(s) may be bonded to a primary or secondary carbon atom of the chain and furthermore the alkyl chain may also be interrupted by oxygen, and/or
  - C_3- to C_{10}-cycloalkoxy groups and/or C_3- to C_{12}-cycloalkenyloxy groups, where the rings may each also be bridged by $-(CH_2)_n-$ groups, where n = 1 to 3, and/or

- mono- and/or oligoglycosyl radicals,

with the proviso that at least 3 radicals from R^1 to R^7 are OH and that at least 2 pairs of adjacent -OH groups are present in the molecule,

or R^2, R^5 and R^6 are OH and the radicals R^1, R^3, R^4 and R^{7-10} are H.

The flavonoids of the formula I to be employed in accordance with the invention include broad-band UV filters, which can be employed alone or in combination with further UV filters. Other, likewise preferred compounds of the formula I exhibit an absorption maximum in the transition region between UV-B and UV-A radiation. As UV-A-II filters, they therefore advantageously supplement the absorption spectrum of commercially available UV-B and UV-A-I filters. They are insoluble or have low solubility in the preparation matrix. In this case, the compounds are preferably dispersed in the preparation in finely divided form. In addition, preferred compounds of this type have advantages on incorporation into the preparations:

- mono- and/or oligoglycosyl radicals improve the water solubility of the compounds to be employed in accordance with the invention;
- straight-chain or branched C_1- to C_{20}-alkoxy groups, in particular long-chain alkoxy functions, such as ethylhexyloxy groups, increase the oil solubility of the compounds;

i.e. the hydrophilicity or lipophilicity of the compounds according to the invention can be controlled via a suitable choice of substituents.

Preferred mono- or oligosaccharide radicals are hexosyl radicals, in particular ramnosyl radicals and glucosyl radicals. However, other hexosyl radicals, for example allosyl, altrosyl, galactosyl, gulosyl, idosyl, mannosyl and talosyl, may also advantageously be used. It may also be advantageous to use pentosyl radicals. The glycosyl radicals may be linked to the basic structure by means of an α- or β-glycosidic link. A preferred disac-

charide is, for example, 6-O-(6-deoxy-α-L-mannopyranosyl)-β-D-glucopyranoside.

On use of the dibenzoylmethane derivatives which are particularly preferred as UV-A filters in combination with the compounds of the formula I, an additional advantage arises: the UV-sensitive dibenzoylmethane derivatives are additionally stabilised by the presence of the compounds of the formula I. The present invention therefore furthermore relates to the use of the compounds of the formula I for the stabilisation of dibenzoylmethane derivatives in preparations.

In principle, all known UV filters are suitable for combination with dibenzoylmethane derivatives and with the compounds of the formula I in formulations according to the invention, for example one or more additional hydrophilic or lipophilic sun-protection filters which are effective in the UV-A region and/or UV-B region and/or IR and/or VIS region (absorbers). These additional filters can be selected, in particular, from cinnamic acid derivatives, salicylic acid derivatives, camphor derivatives, triazine derivatives, β,β-diphenyl acrylate derivatives, p-aminobenzoic acid derivatives and polymeric filters and silicone filters, which are described in the application WO 93/04665. Further examples of organic filters are indicated in Patent Application EP-A 0 487 404. Particular preference is given to UV filters whose physiological acceptability has already been demonstrated. Both for UVA and UVB filters, there are many proven substances which are known from the specialist literature, for example

benzylidenecamphor derivatives, such as 3-(4'-methylbenzylidene)-dl-camphor (for example Eusolex® 6300), 3-benzylidenecamphor (for example Mexoryl® SD), polymers of N-{(2 and 4)-[(2-oxoborn-3-ylidene)methyl]-benzyl}acrylamide (for example Mexoryl® SW), N,N,N-trimethyl-4-(2-

oxoborn-3-ylidenemethyl)anilinium methylsulfate (for example Mexoryl® SK) or (2-oxoborn-3-ylidene)toluene-4-sulfonic acid (for example Mexoryl® SL),

benzoyl- or dibenzoylmethanes, such as 1-(4-tert-butylphenyl)-3-(4-methoxyphenyl)propane-1,3-dione (for example Eusolex® 9020) or 4-isopropyldibenzoylmethane (for example Eusolex® 8020),

benzophenones, such as 2-hydroxy-4-methoxybenzophenone (for example Eusolex® 4360) or 2-hydroxy-4-methoxybenzophenone-5-sulfonic acid and its sodium salt (for example Uvinul® MS-40),

methoxycinnamic acid esters, such as octyl methoxycinnamate (for example Eusolex® 2292), isopentyl 4-methoxycinnamate, for example as a mixture of the isomers (for example Neo Heliopan® E 1000),

salicylate derivatives, such as 2-ethylhexyl salicylate (for example Eusolex® OS), 4-isopropylbenzyl salicylate (for example Megasol®) or 3,3,5-trimethylcyclohexyl salicylate (for example Eusolex® HMS),

4-aminobenzoic acid and derivatives, such as 4-aminobenzoic acid, 2-ethylhexyl 4-(dimethylamino)benzoate (for example Eusolex® 6007) or ethoxylated ethyl 4-aminobenzoate (for example Uvinul® P25),

phenylbenzimidazolesulfonic acids, such as 2-phenylbenzimidazole-5-sulfonic acid and potassium, sodium and triethanolamine salts thereof (for example Eusolex® 232), 2,2-(1,4-phenylene)bisbenzimidazole-4,6-disulfonic acid and salts thereof (for example Neoheliopan® AP) or 2,2-(1,4-phenylene)bisbenzimidazole-6-sulfonic acid;

and further substances, such as
- 2-ethylhexyl 2-cyano-3,3-diphenylacrylate (for example Eusolex® OCR),

- 3,3'-(1,4-phenylenedimethylene)bis(7,7-dimethyl-2-oxobicyclo[2.2.1]hept-1-ylmethanesulfonic acid and salts thereof (for example Mexoryl® SX),
- 2,4,6-trianilino-(p-carbo-2'-ethylhexyl-1'-oxy)-1,3,5-triazine (for example Uvinul® T 150) and
- hexyl 2-(4-diethylamino-2-hydroxybenzoyl)benzoate (for example Uvinul® UVA Plus, BASF).

The compounds mentioned in the list should only be regarded as examples. It is of course also possible to use other UV filters. In particular organic particular UV filters, as described in WO 99/66896, can be advantageously used in formulations according to the present invention.

These organic UV filters are generally incorporated into formulations in an amount of from 0.5 to 10 per cent by weight, preferably 1 – 8%.

Further suitable organic UV filters are, for example,

- 2-(2H-benzotriazol-2-yl)-4-methyl-6-(2-methyl-3-(1,3,3,3-tetramethyl-1-(trimethylsilyloxy)disiloxanyl)propyl)phenol (for example Silatrizole®),
- 2-ethylhexyl 4,4'-[(6-[4-((1,1-dimethylethyl)aminocarbonyl)phenylamino]-1,3,5-triazine-2,4-diyl)diimino]bis(benzoate) (for example Uvasorb® HEB),
- α-(trimethylsilyl)-ω-[trimethylsilyl)oxy]poly[oxy(dimethyl [and about 6% of methyl[2-[p-[2,2-bis(ethoxycarbonyl]vinyl]phenoxy]-1-methyleneethyl] and approximately 1.5% of methyl[3-[p-[2,2-bis(ethoxycarbonyl)vinyl]-phenoxy]propenyl] and from 0.1 to 0.4% of (methylhydrogen]silylene]] ($n \approx 60$) (CAS No. 207 574-74-1)
- 2,2'-methylenebis(6-(2H-benzotriazol-2-yl)-4-(1,1,3,3-tetramethylbutyl)-phenol) (CAS No. 103 597-45-1)
- 2,2'-(1,4-phenylene)bis(1H-benzimidazole-4,6-disulfonic acid, mono-sodium salt) (CAS No. 180 898-37-7),

- 2,4-bis{[4-(2-ethylhexyloxy)-2-hydroxy]phenyl}-6-(4-methoxyphenyl)-1,3,5-triazine (CAS No. 103 597-45-, 187 393-00-6) and
- 4,4´-[(6-[4-((1,1-dimethylethyl)aminocarbonyl)phenylamino]-1,3,5-triazine-2,4-diyl)diimino]bis(benzoic acid-2-ethylhexylester) (for example Uvasorb® HEB).

Further suitable UV filters are methoxyflavones corresponding to the earlier German patent application DE 10232595.2.

Organic UV filters are generally incorporated into formulations in an amount of from 0.5 to 20 per cent by weight, preferably 1 – 15%.
It may furthermore be preferred in accordance with the invention for the preparations to comprise further inorganic UV filters. Preference is given here both to those from the group consisting of titanium dioxides, such as, for example, coated titanium dioxide (for example Eusolex® T-2000 or Eusolex®T-AQUA), zinc oxides (for example Sachtotec®), iron oxides and also cerium oxides. These inorganic UV filters are generally incorporated into preparations in an amount of from 0.5 to 20 per cent by weight, preferably 2-10%. In particular, it may be preferred here for a UV-Filter to be incorporated into one phase of emulsions and a further inorganic UV filter to be incorporated into the other phase.

Preferred compounds having UV-filtering properties are 3-(4'-methylbenzylidene)-dl-camphor, 1-(4-tert-butylphenyl)-3-(4-methoxyphenyl)propane-1,3-dione, 4-isopropyldibenzoylmethane, 2-hydroxy-4-methoxybenzophenone, octyl methoxycinnamate, 3,3,5-trimethylcyclohexyl salicylate, 2-ethylhexyl 4-(dimethylamino)benzoate, 2-ethylhexyl 2-cyano-3,3-diphenylacrylate, 2-phenylbenzimidazole-5-sulfonic acid and its potassium, sodium and triethanolamine salts.

Combining one or more compounds of the above-mentioned UV filters can optimise the protective action against the damaging effects of UV radiation.

Optimised compositions may comprise, for example, the combination of the organic UV filters 4'-methoxy-6-hydroxyflavone with 1-(4-tert-butylphenyl)-3-(4-methoxyphenyl)propane-1,3-dione and 3-(4'-methylbenzylidene)-dl-camphor. This combination gives rise to broad-band protection, which can be supplemented by the addition of inorganic UV filters, such as titanium dioxide microparticles.

All the said UV filters can also be employed in encapsulated form. In particular, it is advantageous to employ organic UV filters in encapsulated form. In detail, the following advantages arise:

- The hydrophilicity of the capsule wall can be set independently of the solubility of the UV filter. Thus, for example, it is also possible to incorporate hydrophobic UV filters into purely aqueous preparations. In addition, the oily impression on application of the preparation comprising hydrophobic UV filters, which is frequently regarded as unpleasant, is suppressed.

- Certain UV filters, in particular dibenzoylmethane derivatives, exhibit only reduced photostability in preparations. Encapsulation of these filters or compounds which impair the photostability of these filters, such as, for example, cinnamic acid derivatives, enables the photostability of the entire preparation to be increased.

- Skin penetration by organic UV filters and the associated potential for irritation on direct application to the human skin is repeatedly being discussed in the literature. The encapsulation of the corresponding substances which is proposed here suppresses this effect.

- In general, encapsulation of individual UV filters or other ingredients enables preparation problems caused by the interaction of individual preparation constituents with one another, such as crystallisation processes, precipitation and agglomerate formation, to be avoided since the interaction is suppressed.

It is therefore preferred in accordance with the invention for one or more of the UV filters to be in encapsulated form. It is advantageous here for the capsules to be so small that they cannot be viewed with the naked eye. In order to achieve the above-mentioned effects, it is furthermore necessary for the capsules to be sufficiently stable and the encapsulated active ingredient (UV filter) only to be released to the environment to a small extent, or not at all.

Suitable capsules can have walls of inorganic or organic polymers. For example, US 6,242,099 B1 describes the production of suitable capsules with walls of chitin, chitin derivatives or polyhydroxylated polyamines. Capsules which can particularly preferably be employed in accordance with the invention have walls which can be obtained by sol-gel processes, as described in the applications WO 00/09652, WO 00/72806 and WO 00/71084. Preference is again given here to capsules whose walls are built up from silica gel (silica; undefined silicon oxide hydroxide). The production of corresponding capsules is known to the person skilled in the art, for example from the cited patent applications, whose contents expressly also belong to the subject-matter of the present application.

The capsules in preparations according to the invention are preferably present in amounts which ensure that the encapsulated UV filters are present in the preparation in the above-indicated amounts.

In accordance with the invention, the above-mentioned UV filters may also be provided with a surface treatment which reinforces the hydrophilic or

hydrophobic properties. Suitable for hydrophobic modification is, for example, a silicone or silane coating.

As is known, the silicones are organosilicon polymers or oligomers having a straight-chain or cyclic, branched or crosslinked structure with various molecular weights which are obtained by polymerisation and/or polycondensation with suitably functionalised silanes and are essentially formed from recurring principal units in which the silicon atoms are linked to one another via oxygen atoms (siloxane bonding), where optionally substituted hydrocarbon groups are bonded directly to the silicon atoms via a carbon atom. The most common hydrocarbon groups are alkyl groups and in particular methyl groups, fluoroalkyl groups, aryl groups and in particular phenyl groups, as well as alkenyl groups and in particular vinyl groups. Further types of group which can be bonded to the siloxane chain either directly or via a hydrocarbon group are, in particular, hydrogen, the halogens and in particular chlorine, bromine or fluorine, the thiols, alkoxy groups, polyoxyalkylene groups (or polyethers) and in particular polyoxyethylene and/or polyoxypropylene, hydroxyl groups or hydroxyalkyl groups, optionally substituted amino groups, amide groups, acyloxy groups or acyloxyalkyl groups, hydroxyalkylamino groups or aminoalkyl groups, quaternary ammonium groups, amphoteric groups or betaine groups, anionic groups, such as carboxylates, thioglycolates, sulfosuccinates, thiosulfates, phosphates and sulfates, this list of course in no way being restrictive (so-called 'organo-modified' silicones).

For the purposes of the present invention, the term 'silicones' is also intended to include and cover the silanes and in particular the alkylsilanes required for their preparation.

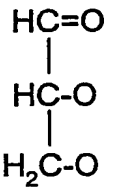
The silicones which are suitable for the present invention and which can be used for sheathing the UV-protection agents are preferably selected from alkylsilanes, polydialkylsiloxanes and polyalkylhydrogenosiloxanes. The sili-

cones are more preferably selected from octyltrimethylsilane, polydimethylsiloxanes and polymethylhydrogenosiloxanes.

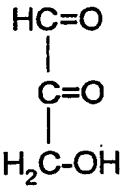
The UV-protection agents may be present in the compositions according to the invention in amounts which are generally in the range from 0.1 to 50% by weight and preferably in amounts which are in the range from 0.5 to 20% by weight, where these amounts are based on the total weight of the composition.

In a further, likewise preferred embodiment of the present invention, the formulation according to the invention comprises at least one self-tanning agent.

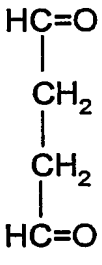
Advantageous self-tanning agents which can be employed are, inter alia:



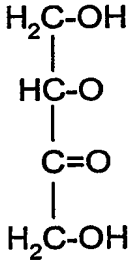
glycerol aldehyde



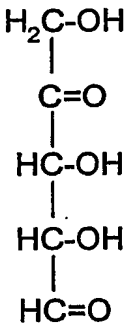
hydroxymethylglyoxal



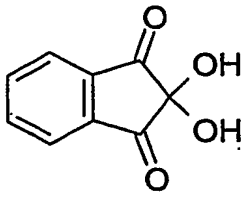
γ-dialdehyde



erythrulose

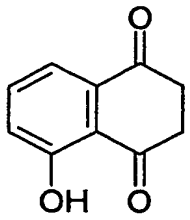


6-aldo-D-fructose



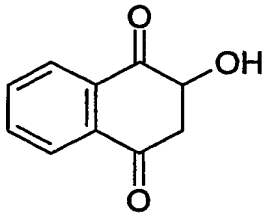
ninhydrin

Mention should also be made of 5-hydroxy-1,4-naphthoquinone (juglone), which is extracted from the shells of fresh walnuts



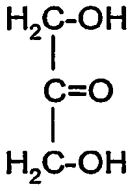
5-hydroxy-1,4-naphthoquinone (juglone)

and 2-hydroxy-1,4-naphthoquinone (lawsone), which occurs in henna leaves



2-hydroxy-1,4-naphthoquinone (lawsone).

Very particular preference is given to 1,3-dihydroxyacetone (DHA), a trifunctional sugar which occurs in the human body, and derivatives thereof.



1,3-dihydroxyacetone (DHA).

The present invention thus furthermore relates to formulations which combine the use of antimicrobial pigments with that of self-tanning agents, in particular dihydroxyacetone or dihydroxyacetone derivatives.

Furthermore, the formulations according to the invention may also comprise dyes and coloured pigments that in general do not show any antimicrobial activity. The dyes and coloured pigments can for example be selected from the corresponding positive list in the German Cosmetics Regulation or the EU list of cosmetic colorants. In most cases, they are identical with the dyes approved for foods. Advantageous coloured pigments are, for example, titanium dioxide, mica, iron oxides (for example Fe_2O_3, Fe_3O_4, $FeO(OH)$) and/or tin oxide. Advantageous dyes are, for example, carmine, Berlin Blue, Chromium Oxide Green, Ultramarine Blue and/or Manganese Violet. It is particularly advantageous to select the dyes and/or coloured pigments from the following list. The Colour Index numbers (CINs) are taken from the Rowe Colour Index, 3rd Edition, Society of Dyers and Colourists, Bradford, England, 1971.

Chemical or other name	CIN	Colour
Pigment Green	10006	green
Acid Green 1	10020	green
2,4-Dinitrohydroxynaphthalene-7-sulfonic acid	10316	yellow
Pigment Yellow 1	11680	yellow
Pigment Yellow 3	11710	yellow
Pigment Orange 1	11725	orange
2,4-Dihydroxyazobenzene	11920	orange
Solvent Red 3	12010	red
1-(2'-Chloro-4'-nitro-1'-phenylazo)-2-hydroxynaphthalene	12085	red
Pigment Red 3	12120	red
Ceres Red; Sudan Red; Fat Red G	12150	red
Pigment Red 112	12370	red
Pigment Red 7	12420	red
Pigment Brown 1	12480	brown
N-(5-chloro-2,4-dimethoxyphenyl)-4-[[5-[(diethylamino)-sulfonyl]-2-methoxyphenyl]azo]-3-hydroxynaphthalene-2-carboxamide	12490	red
Disperse Yellow 16	12700	yellow
1-(4-Sulfo-1-phenylazo)-4-aminobenzene-5-sulfonic acid	13015	yellow

Chemical or other name	CIN	Colour
2,4-Dihydroxy-azobenzene-4'-sulfonic acid	14270	orange
2-(2,4-Dimethylphenylazo-5-sulfonyl)-1-hydroxy-naphthalene-4-sulfonic acid	14700	red
2-(4-Sulfo-1-naphthylazo)-1-naphthol-4-sulfonic acid	14720	red
2-(6-Sulfo-2,4-xylylazo)-1-naphthol-5-sulfonic acid	14815	red
1-(4'-Sulfophenylazo)-2-hydroxynaphthalene	15510	orange
1-(2-Sulfonic acid-4-chloro-5-carboxy-1-phenylazo)-2-hydroxynaphthalene	15525	red
1-(3-Methylphenylazo-4-sulfonyl)-2-hydroxynaphthalene	15580	red
1-(4',(8')-Sulfonyl)-2-hydroxynaphthalene	15620	red
2-Hydroxy-1,2'-azonaphthalene-1'-sulfonic acid	15630	red
3-Hydroxy-4-phenylazo-2-naphthylcarboxylic acid	15800	red
1-(2-Sulfo-4-methyl-1-phenylazo)-2-naphthylcarboxylic acid	15850	red
1-(2-Sulfo-4-methyl-5-chloro-1-phenylazo)-2-hydroxy-naphthalene-3-carboxylic acid	15865	red
1-(2-Sulfo-1-naphthylazo)-2-hydroxynaphthalene-3-carboxylic acid	15880	red
1-(3-Sulfo-1-phenylazo)-2-naphthol-6-sulfonic acid	15980	orange
1-(4-Sulfo-1-phenylazo)-2-naphthol-6-sulfonic acid	15985	yellow
Allura Red	16035	red
1-(4-Sulfo-1-naphthylazo)-2-naphthol-3,6-disulfonic acid	16185	red
Acid Orange 10	16230	orange
1-(4-Sulfo-1-naphthylazo)-2-naphthol-6,8-disulfonic acid	16255	red
1-(4-Sulfo-1-naphthylazo)-2-naphthol-3,6,8-trisulfonic acid	16290	red
8-Amino-2-phenylazo-1-naphthol-3,6-disulfonic acid	17200	red
Acid Red 1	18050	red
Acid Red 155	18130	red
Acid Yellow 121	18690	yellow
Acid Red 180	18736	red
Acid Yellow 11	18820	yellow
Acid Yellow 17	18965	yellow
4-(4-Sulfo-1-phenylazo)-1-(4-sulfophenyl)-5-hydroxy-pyrazolone-3-carboxylic acid	19140	yellow
Pigment Yellow 16	20040	yellow
2,6-(4'-Sulfo-2",4"-dimethyl)bisphenylazo)-1,3-dihydroxy-benzene	20170	orange

Chemical or other name	CIN	Colour
Acid Black 1	20470	black
Pigment Yellow 13	21100	yellow
Pigment Yellow 83	21108	yellow
Solvent Yellow	21230	yellow
Acid Red 163	24790	red
Acid Red 73	27290	red
2-[4'-(4"-Sulfo-1"-phenylazo)-7'-sulfo-1'-naphthylazo]-1-hydroxy-7-aminonaphthalene-3,6-disulfonic acid	27755	black
4-[4"-Sulfo-1"-phenylazo)-7'-sulfo-1'-naphthylazo]-1-hydroxy-8-acetylaminonaphthalene-3,5-disulfonic acid	28440	black
Direct Orange 34, 39, 44, 46, 60	40215	orange
Food Yellow	40800	orange
trans-β-Apo-8'-carotene aldehyde (C_{30})	40820	orange
trans-Apo-8'-carotinic acid (C_{30}) ethyl ester	40850	orange
Canthaxanthine	40850	orange
Acid Blue 1	42045	blue
2,4-Disulfo-5-hydroxy-4'-4"-bis(diethylamino)triphenylcarbinol	42051	blue
4-[(-4-N-Ethyl-p-sulfobenzylamino)-phenyl-(4-hydroxy-2-sulfophenyl)(methylene)-1-(N-ethyl-N-p-sulfobenzyl)-2,5-cyclohexadienimine]	42053	green
Acid Blue 7	42080	blue
(N-Ethyl-p-sulfobenzylamino)phenyl-(2-sulfophenyl)-methylene-(N-ethyl-N-p-sulfobenzyl)-$\Delta^{2,5}$-cyclohexadienimine	42090	blue
Acid Green 9	42100	green
Diethyldisulfobenzyldi-4-amino-2-chlorodi-2-methyl-fuchsonimmonium	42170	green
Basic Violet 14	42510	violet
Basic Violet 2	42520	violet
2'-Methyl-4'-(N-ethyl-N-m-sulfobenzyl)amino-4"-(N-diethyl)-amino-2-methyl-N-ethyl-N-m-sulfobenzylfuchsonimmonium	42735	blue
4'-(N-Dimethyl)amino-4"-(N-phenyl)aminonaphtho-N-dimethylfuchsonimmonium	44045	blue
2-Hydroxy-3,6-disulfo-4,4'-bisdimethylaminonaphtho-fuchsonimmonium	44090	green
Acid Red 52	45100	red

Chemical or other name	CIN	Colour
3-(2'-Methylphenylamino)-6-(2'-methyl-4'-sulfophenylamino)-9-(2"-carboxyphenyl)xanthenium salt	45190	violet
Acid Red 50	45220	red
Phenyl-2-oxyfluorone-2-carboxylic acid	45350	yellow
4,5-Dibromofluorescein	45370	orange
2,4,5,7-Tetrabromofluorescein	45380	red
Solvent Dye	45396	orange
Acid Red 98	45405	red
3',4',5',6'-Tetrachloro-2,4,5,7-tetrabromofluorescein	45410	red
4,5-Diiodofluorescein	45425	red
2,4,5,7-Tetraiodofluorescein	45430	red
Quinophthalone	47000	yellow
Quinophthalonedisulfonic acid	47005	yellow
Acid Violet 50	50325	violet
Acid Black 2	50420	black
Pigment Violet 23	51319	violet
1,2-Dioxyanthraquinone, calcium aluminium complex	58000	red
3-Oxypyrene-5,8,10-sulfonic acid	59040	green
1-Hydroxy-4-N-phenylaminoanthraquinone	60724	violet
1-Hydroxy-4-(4'-methylphenylamino)anthraquinone	60725	violet
Acid Violet 23	60730	violet
1,4-Di(4'-methylphenylamino)anthraquinone	61565	green
1,4-Bis(o-sulfo-p-toluidino)anthraquinone	61570	green
Acid Blue 80	61585	blue
Acid Blue 62	62045	blue
N,N'-Dihydro-1,2,1',2'-anthraquinonazine	69800	blue
Vat Blue 6; Pigment Blue 64	69825	blue
Vat Orange 7	71105	orange
Indigo	73000	blue
Indigodisulfonic acid	73015	blue
4,4'-Dimethyl-6,6'-dichlorothioindigo	73360	red
5,5'-Dichloro-7,7'-dimethylthioindigo	73385	violet
Quinacridone Violet 19	73900	violet
Pigment Red 122	73915	red
Pigment Blue 16	74100	blue
Phthalocyanine	74160	blue
Direct Blue 86	74180	blue

Chemical or other name	CIN	Colour
Chlorinated phthalocyanines	74260	green
Natural Yellow 6, 19; Natural Red 1	75100	yellow
Bixin, Nor-Bixin	75120	orange
Lycopin	75125	yellow
trans-alpha-, beta- or gamma-carotene	75130	orange
Keto and/or hydroxy derivatives of carotene	75135	yellow
Guanine or pearlescent agent	75170	white
1,7-Bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione	75300	yellow
Complex salt (Na, Al, Ca) of carminic acid	75470	red
Chlorophyll a and b; copper compounds of chlorophylls and chlorophyllines	75810	green
Aluminium	77000	white
Aluminium hydroxide	77002	white
Water-containing aluminium silicates	77004	white
Ultramarine	77007	blue
Pigment Red 101 and 102	77015	red
Barium sulfate	77120	white
Bismuth oxychloride and mixtures thereof with mica	77163	white
Calcium carbonate	77220	white
Calcium sulfate	77231	white
Carbon	77266	black
Pigment Black 9	77267	black
Carbo medicinalis vegetabilis	77268:1	black
Chromium oxide	77288	green
Chromium oxide, water-containing	77278	green
Pigment Blue 28, Pigment Green 14	77346	green
Pigment Metal 2	77400	brown
Gold	77480	brown
Iron oxides and hydroxides	77489	orange
Iron oxide	77491	red
Iron oxide hydrate	77492	yellow
Iron oxide	77499	black
Mixtures of iron(II) and iron(III) hexacyanoferrate	77510	blue
Pigment White 18	77713	white
Manganese ammonium diphosphate	77742	violet

Chemical or other name	CIN	Colour
Manganese phosphate; $Mn_3(PO_4)_2 \cdot 7\ H_2O$	77745	red
Silver	77820	white
Titanium dioxide and mixtures thereof with mica	77891	white
Zinc oxide	77947	white
6,7-Dimethyl-9-(1'-D-ribityl)isoalloxazine, lactoflavin		yellow
Sugar dye		brown
Capsanthin, capsorubin		orange
Betanin		red
Benzopyrylium salts, anthocyans		red
Aluminium, zinc, magnesium and calcium stearate		white
Bromothymol Blue		blue

It may furthermore be favourable to select, as dye, one or more substances from the following group:
2,4-dihydroxyazobenzene, 1-(2'-chloro-4'-nitro-1'-phenylazo)-2-hydroxy-naphthalene, Ceres Red, 2-(4-sulfo-1-naphthylazo)-1-naphthol-4-sulfonic acid, the calcium salt of 2-hydroxy-1,2'-azonaphthalene-1'-sulfonic acid, the calcium and barium salts of 1-(2-sulfo-4-methyl-1-phenylazo)-2-naphthyl-carboxylic acid, the calcium salt of 1-(2-sulfo-1-naphthylazo)-2-hydroxy-naphthalene-3-carboxylic acid, the aluminium salt of 1-(4-sulfo-1-phenylazo)-2-naphthol-6-sulfonic acid, the aluminium salt of 1-(4-sulfo-1-naphthylazo)-2-naphthol-3,6-disulfonic acid, 1-(4-sulfo-1-naphthylazo)-2-naphthol-6,8-disulfonic acid, the aluminium salt of 4-(4-sulfo-1-phenylazo)-2-(4-sulfophenyl)-5-hydroxypyrazolone-3-carboxylic acid, the aluminium and zirconium salts of 4,5-dibromofluorescein, the aluminium and zirconium salts of 2,4,5,7-tetrabromofluorescein, 3',4',5',6'-tetrachloro-2,4,5,7-tetrabromofluorescein and its aluminium salt, the aluminium salt of 2,4,5,7-tetraiodofluorescein, the aluminium salt of quinophthalonedisulfonic acid, the aluminium salt of indigodisulfonic acid, red and black iron oxide (CIN: 77 491 (red) and 77 499 (black)), iron oxide hydrate (CIN: 77492), manganese ammonium diphosphate and titanium dioxide.

Also advantageous are oil-soluble natural dyes, such as, for example, paprika extract, β-carotene or cochineal.

Also advantageous for the purposes of the present invention are gel creams comprising effect pigments. Particular preference is given to the types of effect pigment listed below:

1. Natural effect pigments, such as, for example,
   a) "pearl essence" (guanine/hypoxanthine mixed crystals from fish scales) and
   b) "mother of pearl" (ground mussel shells)
2. Monocrystalline effect pigments, such as, for example, bismuth oxychloride (BiOCl)
3. Layered substrate pigments: for example mica/metal oxide

The basis for effect pigments is formed by, for example, pulverulent pigments or castor oil dispersions of bismuth oxychloride and/or titanium dioxide as well as bismuth oxychloride and/or titanium dioxide on mica. The lustre pigment listed under CIN 77163, for example, is particularly advantageous.

Also advantageous are, for example, the following effect pigment types based on mica/metal oxide:

Group	**Coating/layer thickness**	**Colour**
Silver-white effect pigments	TiO_2: 40-60 nm	silver
Interference pigments	TiO_2: 60-80 nm	yellow
	TiO_2: 80-100 nm	red
	TiO_2: 100-140 nm	blue
	TiO_2: 120-160 nm	green
Coloured lustre pigments	Fe_2O_3	bronze
	Fe_2O_3	copper
	Fe_2O_3	red
	Fe_2O_3	red-violet
	Fe_2O_3	red-green

	Fe_2O_3	black
Combination pigments	TiO_2 / Fe_2O_3	gold shades
	TiO_2 / Cr_2O_3	green
	TiO_2 / Berlin Blue	dark blue

Particular preference is given to, for example, the pearlescent pigments available from Merck KGaA under the trade names Timiron®, Colorona® or Dichrona®.

The list of the said effect pigments is of course not intended to be limiting. Effect pigments which are advantageous for the purposes of the present invention can be obtained by numerous routes known per se. In addition, other substrates apart from mica can also, for example, be coated with further metal oxides, such as, for example, silica and the like. For example, TiO_2- and Fe_2O_3-coated SiO_2 particles ("Ronasphere" grades), which are marketed by Merck KGaA and are particularly suitable for the optical reduction of fine wrinkles, are advantageous.

It may additionally be advantageous to completely omit a substrate such as mica. Particular preference is given to effect pigments prepared using SiO_2. Such pigments, which may additionally also have goniochromatic effects, are available, for example, from BASF under the trade name Sicopearl® Fantastico.

It may also be advantageous to employ Engelhard pigments based on calcium sodium borosilicate coated with titanium dioxide. These are available under the name Reflecks®. Due to their particle size of 40-80 µm, they have a glitter effect in addition to the colour.

Also particularly advantageous are effect pigments available from Flora Tech under the trade name Metasomes® Standard/Glitter in various colours (yellow, red, green and blue). The glitter particles here are in the form of

mixtures with various assistants and dyes (such as, for example, the dyes with the colour index (CI) numbers 19140, 77007, 77289 and 77491).

The dyes and pigments can be in individual form or in the form of a mixture and mutually coated with one another, with different colour effects generally being caused by different coating thicknesses. The total amount of dyes and colouring pigments is advantageously selected from the range from, for example, 0.1% by weight to 30% by weight, preferably from 0.5 to 15% by weight, in particular from 1.0 to 10% by weight, in each case based on the total weight of the preparations.

Furthermore, in formulations according to the present invention it is preferred to combine the antimicrobial activity of the inorganic pigments with antioxidant properties of antioxidants. Another subject-matter of the present invention is therefore a formulation having antioxidant properties additionally comprising at least one antioxidant, for example a compound of the formula I as described above. These compounds can be used as antioxidants as well as UV filters.

Preference is therefore also given to formulations comprising at least one compound of the formula I which is characterised in that at least two adjacent radicals of the radicals R^1 to R^4 are OH and at least two adjacent radicals of the radicals R^5 to R^7 are OH.

Particularly preferred formulations comprise at least one compound of the formula I which is characterised in that at least three adjacent radicals of the radicals R^1 to R^4 are OH, preferably with the radicals R^1 to R^3 being OH.

In order that the compounds of the formula I are able to develop their positive action as free-radical scavengers on the skin particularly well, it may be preferred to allow the compounds of the formula I to penetrate into

deeper skin layers. Several possibilities are available for this purpose. Firstly, the compounds of the formula I can have an adequate lipophilicity in order to be able to penetrate through the outer skin layer into epidermal layers. As a further possibility, corresponding transport agents, for example liposomes, which enable transport of the compounds of the formula I through the outer skin layers may also be provided in the preparation. Finally, systemic transport of the compounds of the formula I is also conceivable. The formulations are then designed, for example, in such a way that it is suitable for oral administration.

In general, the substances of the formula I act as free-radical scavengers. Free radicals of this type are not generated only by sunlight, but instead are formed under various conditions. Examples are anoxia, which blocks the flow of electrons upstream of the cytochrome oxidases and causes the formation of superoxide free-radical anions; inflammation associated, inter alia, with the formation of superoxide anions by the membrane NADPH oxidase of the leucocytes, but also associated with the formation (through disproportionation in the presence of iron(II) ions) of the hydroxyl free radicals and other reactive species which are normally involved in the phenomenon of phagocytosis; and lipid autooxidation, which is generally initiated by a hydroxyl free radical and produces lipidic alkoxy free radicals and hydroperoxides.

It is assumed that the preferred compounds of the formula I also act as enzyme inhibitors. They presumably inhibit histidine decarboxylase, protein kinases, elastase, aldose reductase and hyaluronidase, and therefore enable the intactness of the basic substance of vascular sheaths to be maintained. Furthermore, they presumably inhibit non-specifically catechol O-methyl transferase, causing the amount of available catecholamine and thus the vascular strength to be increased. Furthermore, they inhibit AMP phosphodiesterase, giving the substances potential for inhibiting thrombocyte aggregation.

Owing to these properties, the formulations according to the invention are, in general, suitable for immune protection and for the protection of DNA and RNA. In particular, the preparations are suitable for the protection of DNA and RNA against oxidative attack, against free radicals and against damage due to radiation, in particular UV radiation. A further advantage of the preparations according to the invention is cell protection, in particular protection of Langerhans cells against damage due to the above-mentioned influences. All these uses and the use of the compounds of the formula I for the preparation of formulations which can be employed correspondingly are expressly also a subject-matter of the present invention.

Of the phenols having an antioxidative action, the polyphenols, some of which are naturally occurring, are of particular interest for applications in the pharmaceutical, cosmetic or nutrition sector. For example, the flavonoids or bioflavonoids, which are principally known as plant dyes, frequently have an antioxidant potential. K. Lemanska, H. Szymusiak, B. Tyrakowska, R. Zielinski, I.M.C.M. Rietjens; Current Topics in Biophysics 2000, 24(2), 101-108, are concerned with effects of the substitution pattern of mono- and dihydroxyflavones. It is observed therein that dihydroxyflavones containing an OH group adjacent to the keto function or OH groups in the 3',4'- or 6,7- or 7,8-position have antioxidative properties, while other mono- and dihydroxyflavones in some cases do not have antioxidative properties.

Quercetin (cyanidanol, cyanidenolon 1522, meletin, sophoretin, ericin, 3,3',4',5,7-pentahydroxyflavone) is frequently mentioned as a particularly effective antioxidant (for example C.A. Rice-Evans, N.J. Miller, G. Paganga, Trends in Plant Science 1997, 2(4), 152-159). K. Lemanska, H. Szymusiak, B. Tyrakowska, R. Zielinski, A.E.M.F. Soffers, I.M.C.M. Rietjens; Free Radical Biology&Medicine 2001, 31(7), 869-881, have investigated the pH dependence of the antioxidant action of hydroxy-

flavones. Quercetin exhibits the greatest activity amongst the structures investigated over the entire pH range.

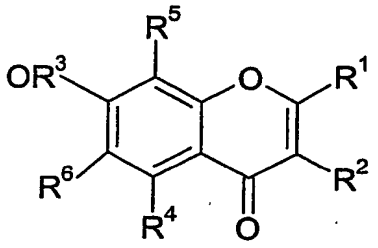
For the purposes of the invention, the term flavone derivatives is taken to mean flavonoids and coumaranones. For the purposes of the invention, the term flavonoids is taken to mean the glycosides of flavonones, flavones, 3-hydroxyflavones (= flavonols), aurones, isoflavones and rotenoids [Römpp Chemie Lexikon [Römpp's Lexicon of Chemistry], Volume 9, 1993]. For the purposes of the present invention, however, this is also taken to mean the aglycones, i.e. the sugar-free constituents, and flavonoid and aglycone derivatives. For the purposes of the present invention, the term flavonoid is furthermore also taken to mean anthocyanidine (cyanidine). For the purposes of the present invention, the term coumaranones is also taken to mean derivatives thereof.

Preferred flavonoids are derived from flavonones, flavones, 3-hydroxy-flavones, aurones and isoflavones, in particular from flavonones, flavones, 3-hydroxyflavones and aurones.

The flavonoids are preferably selected from the following compounds: 4,6,3′,4′-tetrahydroxyaurone, quercetin, rutin, isoquercetin, eriodictyol, taxifolin, luteolin, trishydroxyethylquercetin (troxequercetin), trishydroxyethylrutin (troxerutin), trishydroxyethylisoquercetin (troxeisoquercetin), trishydroxyethylluteolin (troxeluteolin), α-glycosylrutin, tiliroside and sulfates and phosphates thereof. Of the flavonoids, particular preference is given to rutin, tiliroside, α-glycosylrutin and troxerutin as active compounds according to the invention.

Of the coumaranones, 4,6,3′,4′-tetrahydroxybenzyl-3-coumaranone is preferred.

The term chromone derivatives is preferably taken to mean certain chromen-2-one derivatives which are suitable as active ingredients for the preventative treatment of human skin and human hair against ageing processes and harmful environmental influences. At the same time, they exhibit a low irritation potential for the skin, have a positive effect on water binding in the skin, maintain or increase the elasticity of the skin and thus promote smoothing of the skin. These compounds preferably conform to the formula II



II

where

R^1 and R^2 may be identical or different and are selected from

- H, -C(=O)-R^7, -C(=O)-OR^7,
- straight-chain or branched C_1- to C_{20}-alkyl groups,
- straight-chain or branched C_3- to C_{20}-alkenyl groups,
- straight-chain or branched C_1- to C_{20}-hydroxyalkyl groups, where the hydroxyl group can be bonded to a primary or secondary carbon atom in the chain and furthermore the alkyl chain may also be interrupted by oxygen, and/or
- C_3- to C_{10}-cycloalkyl groups and/or C_3- to C_{12}-cycloalkenyl groups, where the rings may each also be bridged by -$(CH_2)_n$- groups, where n = 1 to 3,

R^3 is H or straight-chain or branched C_1- to C_{20}-alkyl groups,

R^4 is H or OR^8,

R^5 and R^6 may be identical or different and are selected from

- -H, -OH,
- straight-chain or branched C_1- to C_{20}-alkyl groups,

- straight-chain or branched C_3- to C_{20}-alkenyl groups,
- straight-chain or branched C_1- to C_{20}-hydroxyalkyl groups, where the hydroxyl group can be bonded to a primary or secondary carbon atom in the chain and furthermore the alkyl chain may also be interrupted by oxygen, and

R^7 is H, straight-chain or branched C_1- to C_{20}-alkyl groups, a polyhydroxy compound, such as preferably an ascorbic acid radical or glycosidic radicals, and

R^8 is H or straight-chain or branched C_1- to C_{20}-alkyl groups, where at least 2 of the substituents R^1, R^2 and R^4-R^6 are not H or at least one substituent from R^1 and R^2 is $-C(=O)-R^7$ or $-C(=O)-OR^7$.

The proportion of one or more compounds selected from flavonoids, chromone derivatives and coumaranones in the preparation according to the invention is preferably from 0.001 to 5% by weight, particularly preferably from 0.01 to 2% by weight, based on the preparation as a whole.

As already described, preferred formulations according to the invention are also suitable for the treatment of skin diseases associated with a defect in keratinisation which affects differentiation and cell proliferation, in particular for the treatment of acne vulgaris, acne comedonica, polymorphic acne, acne rosaceae, nodular acne, acne conglobata, age-induced acne, acne which arises as a side effect, such as acne solaris, medicament-induced acne or acne professionalis, for the treatment of other defects in keratinisation, in particular ichthyosis, ichthyosiform states, Darier's disease, keratosis palmoplantaris, leucoplasia, leucoplasiform states, herpes of the skin and mucous membrane (buccal) (lichen), for the treatment of other skin diseases associated with a defect in keratinisation and which have an inflammatory and/or immunoallergic component and in particular all forms of psoriasis which affect the skin, mucous membranes and fingers and toenails, and psoriatic rheumatism and skin atopia, such as eczema or respiratory atopia, or hypertrophy of the gums, it furthermore being possible

for the compounds to be used for some inflammations which are not associated with a defect in keratinisation, for the treatment of all benign or malignant excrescence of the dermis or epidermis, which may be of viral origin, such as verruca vulgaris, verruca plana, epidermodysplasia verruciformis, oral papillomatosis, papillomatosis florida, and excrescence which may be caused by UV radiation, in particular epithelioma baso-cellulare and epithelioma spinocellulare, for the treatment of other skin diseases, such as dermatitis bullosa and diseases affecting the collagen, for the treatment of certain eye diseases, in particular corneal diseases, for overcoming or combating light-induced skin ageing associated with ageing, for reducing pigmentation and keratosis actinica and for the treatment of all diseases associated with normal ageing or light-induced ageing, for the prevention or healing of wounds/scars of atrophia of the epidermis and/or dermis caused by locally or systemically applied corticosteroids and all other types of skin atrophia, for the prevention or treatment of defects in wound healing, for the prevention or elimination of stretch marks caused by pregnancy or for the promotion of wound healing, for combating defects in tallow production, such as hyperseborrhoea in acne or simple seborrhoea, for combating or preventing cancer-like states or pre-carcinogenic states, in particular promyelocytic leukaemia, for the treatment of inflammatory diseases, such as arthritis, for the treatment of all virus-induced diseases of the skin or other areas of the body, for the prevention or treatment of alopecia, for the treatment of skin diseases or diseases of other areas of the body with an immunological component, for the treatment of cardiovascular diseases, such as arteriosclerosis or hypertension, and of non-insulin-dependent diabetes, and for the treatment of skin problems caused by UV radiation.

The protective action against oxidative stress or against the effect of free radicals can thus be further improved if the formulations comprise one or more further antioxidants. The person skilled in the art being presented with

absolutely no difficulties in selecting suitably fast-acting or time-delayed antioxidants.

In a preferred embodiment of the present invention, the formulations are therefore preparations for the protection of body cells against oxidative stress, in particular for reducing skin ageing, characterised in that they preferably comprise one or more further antioxidants besides the one or more compounds of the formula I.

There are many proven substances known from the specialist literature which also can be used as antioxidants, for example amino acids (for example glycine, histidine, tyrosine, tryptophan) and derivatives thereof, imidazoles (for example urocanic acid) and derivatives thereof, peptides, such as D,L-carnosine, D-carnosine, L-carnosine and derivatives thereof (for example anserine), carotinoids, carotenes (for example α-carotene, β-carotene, lycopene) and derivatives thereof, chlorogenic acid and derivatives thereof, lipoic acid and derivatives thereof (for example dihydrolipoic acid), aurothioglucose, propylthiouracil and other thiols (for example thioredoxin, glutathione, cysteine, cystine, cystamine and the glycosyl, N-acetyl, methyl, ethyl, propyl, amyl, butyl and lauryl, palmitoyl, oleyl, γ-linoleyl, cholesteryl and glyceryl esters thereof) and salts thereof, dilauryl thiodipropionate, distearyl thiodipropionate, thiodipropionic acid and derivatives thereof (esters, ethers, peptides, lipids, nucleotides, nucleosides and salts), and sulfoximine compounds (for example buthionine sulfoximines, homocysteine sulfoximine, buthionine sulfones, penta-, hexa- and heptathionine sulfoximine) in very low tolerated doses (for example pmol to μmol/kg), and also (metal) chelating agents (for example α-hydroxy fatty acids, palmitic acid, phytic acid, lactoferrin), α-hydroxy acids (for example citric acid, lactic acid, malic acid), humic acid, bile acid, bile extracts, bilirubin, biliverdin, EDTA, EGTA and derivatives thereof, unsaturated fatty acids and derivatives thereof, vitamin C and derivatives

(for example ascorbyl palmitate, magnesium ascorbyl phosphate, ascorbyl acetate), tocopherols and derivatives (for example vitamin E acetate), vitamin A and derivatives (for example vitamin A palmitate), and coniferyl benzoate of benzoin resin, rutinic acid and derivatives thereof, α-glycosyl rutin, ferulic acid, furfurylideneglucitol, carnosine, butylhydroxytoluene, butylhydroxyanisole, nordihydroguaiaretic acid, trihydroxybutyrophenone, quercetin, uric acid and derivatives thereof, mannose and derivatives thereof, zinc and derivatives thereof (for example ZnO, $ZnSO_4$), selenium and derivatives thereof (for example selenomethionine), stilbenes and derivatives thereof (for example stilbene oxide, trans-stilbene oxide).

Mixtures of antioxidants are likewise suitable for use in the formulations according to the invention. Known and commercial mixtures are, for example, mixtures comprising, as active ingredients, lecithin, L-(+)-ascorbyl palmitate and citric acid (for example Oxynex® AP), natural tocopherols, L-(+)-ascorbyl palmitate, L-(+)-ascorbic acid and citric acid (for example Oxynex® K LIQUID), tocopherol extracts from natural sources, L-(+)-ascorbyl palmitate, L-(+)-ascorbic acid and citric acid (for example Oxynex® L LIQUID), DL-α-tocopherol, L-(+)-ascorbyl palmitate, citric acid and lecithin (for example Oxynex® LM) or butylhydroxytoluene (BHT), L-(+)-ascorbyl palmitate and citric acid (for example Oxynex® 2004). Antioxidants of this type are usually employed with compounds of the formula I in compositions of this type in ratios in the range from 1000:1 to 1:1000, preferably in amounts of from 100:1 to 1:100.

The formulations according to the invention may comprise vitamins as further ingredients. The formulations according to the invention preferably comprise vitamins and vitamin derivatives selected from vitamin A, vitamin A propionate, vitamin A palmitate, vitamin A acetate, retinol, vitamin B, thiamine chloride hydrochloride (vitamin B_1), riboflavin (vitamin B_2), nicotinamide, vitamin C (ascorbic acid), vitamin D, ergocalciferol (vitamin

D_2), vitamin E, DL-α-tocopherol, tocopherol E acetate, tocopherol hydrogensuccinate, vitamin K_1, esculin (vitamin P active ingredient), thiamine (vitamin B_1), nicotinic acid (niacin), pyridoxine, pyridoxal, pyridoxamine, (vitamin B_6), pantothenic acid, biotin, folic acid and cobalamine (vitamin B_{12}), particularly preferably vitamin A palmitate, vitamin C and derivatives thereof, DL-α-tocopherol, tocopherol E acetate, nicotinic acid, pantothenic acid and biotin. Vitamins are usually employed here with compounds of the formula I in ratios in the range from 1000:1 to 1:1000, preferably in amounts of from 100:1 to 1:100.

The formulations according to the invention may in addition comprise further conventional skin-protecting or skin-care active ingredients. These may in principle be any active ingredients known to the person skilled in the art.

Particularly preferred active ingredients are pyrimidinecarboxylic acids and/or aryl oximes.

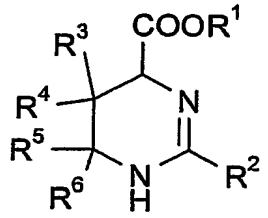
Pyrimidinecarboxylic acids occur in halophilic microorganisms and play a role in osmoregulation of these organisms (*E.A. Galinski et al., Eur. J. Biochem., 149 (1985) pages 135-139*). Of the pyrimidinecarboxylic acids, particular mention should be made here of ectoin ((S)-1,4,5,6-tetrahydro-2-methyl-4-pyrimidinecarboxylic acid) and hydroxyectoin ((S,S)-1,4,5,6-tetrahydro-5-hydroxy-2-methyl-4-pyrimidinecarboxylic acid) and derivatives thereof. These compounds stabilise enzymes and other biomolecules in aqueous solutions and organic solvents. Furthermore, they stabilise, in particular, enzymes against denaturing conditions, such as salts, extreme pH values, surfactants, urea, guanidinium chloride and other compounds.

Ectoin and ectoin derivatives, such as hydroxyectoin, can advantageously be employed in medicaments. In particular, hydroxyectoin can be employed for the preparation of a medicament for the treatment of skin diseases.

Other areas of application of hydroxyectoin and other ectoin derivatives are typically in areas in which, for example, trehalose is used as additive. Thus, ectoin derivatives, such as hydroxyectoin, can be used as protectant in dried yeast and bacteria cells. Pharmaceutical products, such as non-glycosylated, pharmaceutically active peptides and proteins, for example t-PA, can also be protected with ectoin or its derivatives.

Of the cosmetic applications, particular mention should be made of the use of ectoin and ectoin derivatives for the care of aged, dry or irritated skin. Thus, European Patent Application EP-A-0 671 161 describes, in particular, that ectoin and hydroxyectoin are employed in cosmetic preparations, such as powders, soaps, surfactant-containing cleansing products, lipsticks, rouge, make-ups, care creams and sunscreen preparations.

Preference is given here to the use of a pyrimidinecarboxylic acid of the following formula III



III

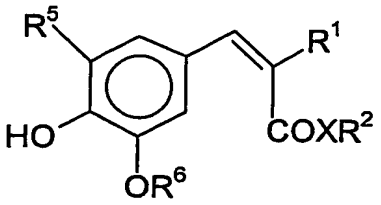
in which R^1 is a radical H or C1-8-alkyl, R^2 is a radical H or C1-4-alkyl, and R^3, R^4, R^5 and R^6 are each, independently of one another, a radical from the group consisting of H, OH, NH_2 and C1-4-alkyl. Preference is given to the use of pyrimidinecarboxylic acids in which R^2 is a methyl or ethyl group, and R^1 or R^5 and R^6 are H. Particular preference is given to the use of the pyrimidinecarboxylic acids ectoin ((S)-1,4,5,6-tetrahydro-2-methyl-4-pyrimidinecarboxylic acid) and hydroxyectoin ((S,S)-1,4,5,6-tetrahydro-5-hydroxy-2-methyl-4-pyrimidinecarboxylic acid). The preparations according to the invention preferably comprise pyrimidinecarboxylic acids of this type in

amounts of up to 15% by weight. In combination with compounds of formula I, the pyrimidinecarboxylic acids are preferably employed in ratios of from 100:1 to 1:100 with respect to the compounds of the formula I, with ratios in the range from 1:10 to 10:1 being particularly preferred.

Of the aryl oximes, preference is given to the use of 2-hydroxy-5-methyl-laurophenone oxime, which is also known as HMLO, LPO or F5. Its suitability for use in cosmetic compositions is disclosed, for example, in DE-A-41 16 123. Preparations which comprise 2-hydroxy-5-methyllaurophenone oxime are accordingly suitable for the treatment of skin diseases which are accompanied by inflammation. It is known that preparations of this type can be used, for example, for the therapy of psoriasis, various forms of eczema, irritative and toxic dermatitis, UV dermatitis and further allergic and/or inflammatory diseases of the skin and integumentary appendages. Preparations according to the invention which, in addition to the compound of the formula I, additionally comprise an aryl oxime, preferably 2-hydroxy-5-methyllaurophenone oxime, exhibit surprising antiinflammatory suitability. The preparations here preferably comprise from 0.01 to 10% by weight of the aryl oxime, it being particularly preferred for the preparation to comprise from 0.05 to 5% by weight of aryl oxime.

All compounds or components which can be used in the preparations are either known or are commercially available or can be synthesised by known processes.

Besides the compounds described here, the formulations according to the invention may also comprise at least one photostabiliser, preferably conforming to the formula IV



IV,

where

R^1 is selected from $-C(O)CH_3$, $-CO_2R^3$, $-C(O)NH_2$ and $-C(O)N(R^4)_2$;

X is O or NH;

R^2 is a linear or branched C_{1-30}-alkyl radical;

R^3 is a linear or branched C_{1-20}-alkyl radical,

all R^4, independently of one another, are H or linear or branched C_{1-8}-alkyl radicals,

R^5 is H, a linear or branched C_{1-8}-alkyl radical or a linear or branched $-O-C_{1-8}$-alkyl radical, and

R^6 is a C_{1-8}-alkyl radical,

where the photostabiliser is particularly preferably bis(2-ethylhexyl) 2-(4-hydroxy-3,5-dimethoxybenzylidene)malonate. Corresponding photostabilisers and their preparation and use are described in International Patent Application WO 03/007906, the disclosure content of which expressly also belongs to the subject-matter of the present application.

The formulations according to the invention can be prepared by processes that are well known to the person skilled in the art, in particular by the processes that serve for the preparation of oil-in-water emulsions or water-in-oil emulsions.

The present invention furthermore relates to formulations having antimicrobial properties comprising the antimicrobial pigments and one or more cosmetically or dermatologically suitable vehicles, to a process for the production of a preparation which is characterised in that at least one

antimicrobial pigment is mixed with a cosmetically or dermatologically suitable vehicle.

These compositions can be, in particular, in the form of simple or complex emulsions (O/W, W/O, O/W/O or W/O/W), such as creams, milks, gels, or gel-creams, powders and solid sticks, and they may, if desired, be formulated as aerosols and be in the form of foams or sprays.

The compositions according to the invention can be used as compositions for protection of the human epidermis or of the hair against UV radiation, as sunscreens or make-up products.

It should be pointed out that in the formulations according to the invention for sun protection which have a vehicle of the oil-in-water emulsion type, the aqueous phase (which comprises, in particular, the hydrophilic filters) generally makes up from 50 to 95% by weight and preferably from 70 to 90% by weight, based on the formulation as a whole, the oil phase (which comprises, in particular, the lipophilic filters) makes up from 5 to 50% by weight and preferably from 10 to 30% by weight, based on the formulation as a whole, and the (co)emulsifier or (co)emulsifiers make(s) up from 0.5 to 20% by weight and preferably from 2 to 10% by weight, based on the formulation as a whole.

For example, the one or more compounds of the formula I can be incorporated into cosmetic or dermatological preparations in the customary manner. Suitable preparations are those for external use, for example in the form of a cream, lotion or gel or as a solution that can be sprayed onto the skin. Suitable for internal use are administration forms such as capsules, coated tablets, powders, tablet solutions or solutions.

Examples which may be mentioned of application forms of the preparations according to the invention are: solutions, suspensions, emulsions, PIT

emulsions, pastes, ointments, gels, creams, lotions, powders, soaps, surfactant-containing cleansing preparations, oils, aerosols and sprays. Examples of other application forms are sticks, shampoos and shower preparations. Any desired customary excipients, auxiliaries and, if desired, further active ingredients may be added to the preparation.

Preferred auxiliaries originate from the group consisting of preservatives, antioxidants, stabilisers, solubilisers, vitamins, colorants and odour improvers.

Ointments, pastes, creams and gels may comprise the customary excipients, for example animal and vegetable fats, waxes, paraffins, starch, tragacanth, cellulose derivatives, polyethylene glycols, silicones, bentonites, silica, talc and zinc oxide, or mixtures of these substances.

Powders and sprays may comprise the customary excipients, for example lactose, talc, silica, aluminium hydroxide, calcium silicate and polyamide powder, or mixtures of these substances. Sprays may additionally comprise the customary propellants, for example chlorofluorocarbons, propane/butane or dimethyl ether.

Solutions and emulsions may comprise the customary excipients, such as solvents, solubilisers and emulsifiers, for example water, ethanol, isopropanol, ethyl carbonate, ethyl acetate, benzyl alcohol, benzyl benzoate, propylene glycol, 1,3-butyl glycol, oils, in particular cottonseed oil, peanut oil, wheatgerm oil, olive oil, castor oil and sesame oil, glycerol fatty acid esters, polyethylene glycols and fatty acid esters of sorbitan, or mixtures of these substances.

Suspensions may comprise the customary excipients, such as liquid diluents, for example water, ethanol or propylene glycol, suspending agents, for example ethoxylated isostearyl alcohols, polyoxyethylene sorbitol esters

and polyoxyethylene sorbitan esters, microcrystalline cellulose, aluminium metahydroxide, bentonite, agar-agar and tragacanth, or mixtures of these substances.

Soaps may comprise the customary excipients, such as alkali metal salts of fatty acids, salts of fatty acid monoesters, fatty acid protein hydrolysates, isethionates, lanolin, fatty alcohol, vegetable oils, plant extracts, glycerol, sugars, or mixtures of these substances.

Surfactant-containing cleansing products can comprise the conventional carriers, such as salts of fatty alcohol sulfates, fatty alcohol ether sulfates, sulfosuccinic acid monoesters, fatty acid albumen hydrolysates, isothionates, imidazolinium derivatives, methyl taurates, sarcosinates, fatty acid amide ether sulfates, alkylamidobetaines, fatty alcohols, fatty acid glycerides, fatty acid diethanolamides, vegetable and synthetic oils, lanolin derivatives, ethoxylated glycerol fatty acid esters or mixtures of these substances.

Face and body oils may comprise the customary excipients, such as synthetic oils, such as fatty acid esters, fatty alcohols, silicone oils, natural oils, such as vegetable oils and oily plant extracts, paraffin oils or lanolin oils, or mixtures of these substances.

Further typical cosmetic application forms are also lipsticks, lip-care sticks, mascara, eyeliner, eye-shadow, rouge, powder make-up, emulsion make-up and wax make-up, and sunscreen, pre-sun and after-sun preparations.

The preferred preparation forms according to the invention include, in particular, emulsions.

Emulsions according to the invention are advantageous and comprise, for example, the said fats, oils, waxes and other fatty substances, as well as water and an emulsifier, as usually used for a preparation of this type.

The lipid phase may advantageously be selected from the following group of substances:

- mineral oils, mineral waxes;
- oils, such as triglycerides of capric or caprylic acid, furthermore natural oils, such as, for example, castor oil;
- fats, waxes and other natural and synthetic fatty substances, preferably esters of fatty acids with alcohols having a low carbon number, for example with isopropanol, propylene glycol or glycerol, or esters of fatty alcohols with alkanoic acids having a low carbon number or with fatty acids;
- silicone oils, such as dimethylpolysiloxanes, diethylpolysiloxanes, diphenylpolysiloxanes and mixed forms thereof.

For the purposes of the present invention, the oil phase of the emulsions, oleogels or hydrodispersions or lipodispersions is advantageously selected from the group consisting of esters of saturated and/or unsaturated, branched and/or unbranched alkanecarboxylic acids having a chain length of from 3 to 30 carbon atoms and saturated and/or unsaturated, branched and/or unbranched alcohols having a chain length of from 3 to 30 carbon atoms, or from the group consisting of esters of aromatic carboxylic acids and saturated and/or unsaturated, branched and/or unbranched alcohols having a chain length of from 3 to 30 carbon atoms. Ester oils of this type can then advantageously be selected from the group consisting of isopropyl myristate, isopropyl palmitate, isopropyl stearate, isopropyl oleate, n-butyl stearate, n-hexyl laurate, n-decyl oleate, isooctyl stearate, isononyl stearate, isononyl isononanoate, 2-ethylhexyl palmitate, 2-ethylhexyl laurate, 2-hexyldecyl stearate, 2-octyldodecyl palmitate, oleyl oleate, oleyl

erucate, erucyl oleate, erucyl erucate and synthetic, semi-synthetic and natural mixtures of esters of this type, for example jojoba oil.

The oil phase may furthermore advantageously be selected from the group consisting of branched and unbranched hydrocarbons and waxes, silicone oils, dialkyl ethers, or the group consisting of saturated and unsaturated, branched and unbranched alcohols, and fatty acid triglycerides, specifically the triglycerol esters of saturated and/or unsaturated, branched and/or unbranched alkanecarboxylic acids having a chain length of from 8 to 24, in particular 12-18, carbon atoms. The fatty acid triglycerides may advantageously be selected, for example, from the group consisting of synthetic, semi-synthetic and natural oils, for example olive oil, sunflower oil, soya oil, peanut oil, rapeseed oil, almond oil, palm oil, coconut oil, palm kernel oil and the like.

Any desired mixtures of oil and wax components of this type may also advantageously be employed for the purposes of the present invention. It may also be advantageous to employ waxes, for example cetyl palmitate, as the only lipid component of the oil phase.

The oil phase is advantageously selected from the group consisting of 2-ethylhexyl isostearate, octyldodecanol, isotridecyl isononanoate, isoeicosane, 2-ethylhexyl cocoate, C_{12-15}-alkyl benzoate, caprylic/capric acid triglyceride and dicapryl ether.

Particularly advantageous are mixtures of C_{12-15}-alkyl benzoate and 2-ethylhexyl isostearate, mixtures of C_{12-15}-alkyl benzoate and isotridecyl isononanoate, as well as mixtures of C_{12-15}-alkyl benzoate, 2-ethylhexyl isostearate and isotridecyl isononanoate.

Of the hydrocarbons, paraffin oil, squalane and squalene may advantageously be used for the purposes of the present invention.

Furthermore, the oil phase may also advantageously have a content of cyclic or linear silicone oils or consist entirely of oils of this type, although it is preferred to use an additional content of other oil-phase components in addition to the silicone oil or the silicone oils.

The silicone oil to be used in accordance with the invention is advantageously cyclomethicone (octamethylcyclotetrasiloxane). However, it is also advantageous for the purposes of the present invention to use other silicone oils, for example hexamethylcyclotrisiloxane, polydimethylsiloxane or poly(methylphenylsiloxane).

Also particularly advantageous are mixtures of cyclomethicone and isotridecyl isononanoate and of cyclomethicone and 2-ethylhexyl isostearate.

The aqueous phase of the preparations according to the invention optionally advantageously comprises alcohols, diols or polyols having a low carbon number, and ethers thereof, preferably ethanol, isopropanol, propylene glycol, glycerol, ethylene glycol, ethylene glycol monoethyl or monobutyl ether, propylene glycol monomethyl, monoethyl or monobutyl ether, diethylene glycol monomethyl or monoethyl ether and analogous products, furthermore alcohols having a low carbon number, for example ethanol, isopropanol, 1,2-propanediol or glycerol, and, in particular, one or more thickeners, which may advantageously be selected from the group consisting of silicon dioxide, aluminium silicates, polysaccharides and derivatives thereof, for example hyaluronic acid, xanthan gum, hydroxypropylmethylcellulose, particularly advantageously from the group consisting of the polyacrylates, preferably a polyacrylate from the group consisting of the so-called Carbopols, for example Carbopol grades 980, 981, 1382, 2984 or 5984, in each case individually or in combination.

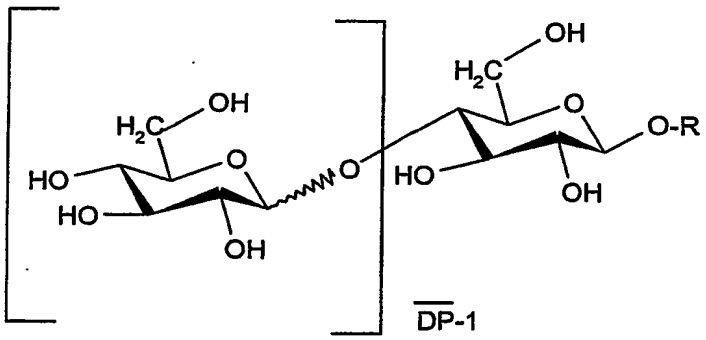
In particular, mixtures of the above-mentioned solvents are used. In the case of alcoholic solvents, water may be a further constituent.

Emulsions according to the invention are advantageous and comprise, for example, the said fats, oils, waxes and other fatty substances, as well as water and an emulsifier, as usually used for a formulation of this type.

In a preferred embodiment, the preparations according to the invention comprise hydrophilic surfactants.

The hydrophilic surfactants are preferably selected from the group consisting of the alkylglucosides, acyl lactylates, betaines and coconut amphoacetates.

The alkylglucosides are themselves advantageously selected from the group consisting of the alkylgluosides which are distinguished by the structural formula



where R is a branched or unbranched alkyl radical having from 4 to 24 carbon atoms, and where $\overline{DP}$ denotes a mean degree of glucosylation of up to 2.

The value $\overline{DP}$ represents the degree of glucosidation of the alkylglucosides used in accordance with the invention and is defined as

$$\overline{DP} = \frac{p_1}{100} \cdot 1 + \frac{p_2}{100} \cdot 2 + \frac{p_3}{100} \cdot 3 + \ldots = \sum \frac{p_i}{100} \cdot i$$

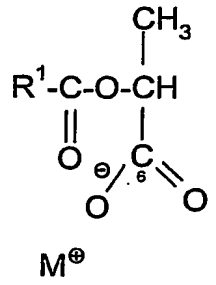
in which p_1, p_2, p_3 ... p_i represent the proportion of mono-, di-, tri- ... i-fold glucosylated products in per cent by weight. Advantageous according to the invention are products having degrees of glucosylation of 1-2, particularly advantageously of from 1.1 to 1.5, very particularly advantageously of 1.2-1.4, in particular of 1.3.

The value DP takes into account the fact that alkylglucosides are generally, as a consequence of their preparation, in the form of mixtures of mono- and oligoglucosides. A relatively high content of monoglucosides, typically in the order of 40-70% by weight, is advantageous in accordance with the invention.

Alkylglycosides which are particularly advantageously used for the purposes of the invention are selected from the group consisting of octyl glucopyranoside, nonyl glucopyranoside, decyl glucopyranoside, undecyl glucopyranoside, dodecyl glucopyranoside, tetradecyl glucopyranoside and hexadecyl glucopyranoside.

It is likewise advantageous to employ natural or synthetic raw materials and auxiliaries or mixtures which are distinguished by an effective content of the active ingredients used in accordance with the invention, for example Plantaren® 1200 (Henkel KGaA), Oramix® NS 10 (Seppic).

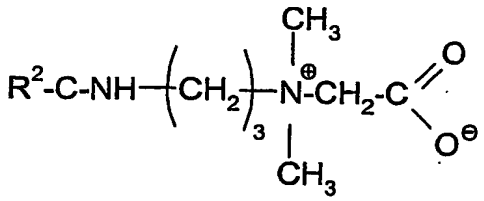
The acyllactylates are themselves advantageously selected from the group consisting of the substances which are distinguished by the structural formula



where R^1 is a branched or unbranched alkyl radical having from 1 to 30 carbon atoms, and M^+ is selected from the group consisting of the alkali metal ions and the group consisting of ammonium ions which are substituted by one or more alkyl and/or one or more hydroxyalkyl radicals, or corresponds to half an equivalent of an alkaline earth metal ion.

For example, sodium isostearyl lactylate, for example the product Pathionic® ISL from the American Ingredients Company, is advantageous.

The betaines are advantageously selected from the group consisting of the substances which are distinguished by the structural formula



where R^2 is a branched or unbranched alkyl radical having from 1 to 30 carbon atoms.

R^2 is particularly advantageously a branched or unbranched alkyl radical having from 6 to 12 carbon atoms.

For example, capramidopropylbetaine, for example the product Tego® Betain 810 from Th. Goldschmidt AG, is advantageous.

A coconut amphoacetate which is advantageous for the purposes of the invention is, for example, sodium coconut amphoacetate, as available under the name Miranol® Ultra C32 from Miranol Chemical Corp.

The preparations according to the invention are advantageously characterised in that the hydrophilic surfactant(s) is (are) present in concentrations of 0.01-20% by weight, preferably 0.05-10% by weight, particularly preferably 0.1-5% by weight, in each case based on the total weight of the composition.

For use, the cosmetic and dermatological preparations according to the invention are applied to the skin and/or the hair in an adequate amount in the usual manner for cosmetics.

Cosmetic and dermatological preparations according to the invention may exist in various forms. Thus, they may be, for example, a solution, a water-free preparation, an emulsion or microemulsion of the water-in-oil (W/O) or oil-in-water (O/W) type, a multiple emulsion, for example of the water-in-oil-in-water (W/O/W) type, a gel, a solid stick, an ointment or an aerosol. It is also advantageous to administer ectoins in encapsulated form, for example in collagen matrices and other conventional encapsulation materials, for example as cellulose encapsulations, in gelatine, wax matrices or liposomally encapsulated. In particular, wax matrices, as described in DE-A 43 08 282, have proven favourable. Preference is given to emulsions. O/W emulsions are particularly preferred. Emulsions, W/O emulsions and O/W emulsions are obtainable in a conventional manner.

Emulsifiers that can be used are, for example, the known W/O and O/W emulsifiers. It is advantageous to use further conventional co-emulsifiers in the preferred O/W emulsions according to the invention. The commercially

available product Ceralution C (Sasol) has to be proven to be in particular advantageous as emulsifier.

Co-emulsifiers which are advantageous according to the invention are, for example, O/W emulsifiers, principally from the group consisting of the substances having HLB values of 11-16, very particularly advantageously having HLB values of 14.5-15.5, so long as the O/W emulsifiers have saturated radicals R and R'. If the O/W emulsifiers have unsaturated radicals R and/or R' or in the case of isoalkyl derivatives, the preferred HLB value of such emulsifiers may also be lower or higher.

It is advantageous to select the fatty alcohol ethoxylates from the group consisting of ethoxylated stearyl alcohols, cetyl alcohols, cetylstearyl alcohols (cetearyl alcohols). Particular preference is given to the following: polyethylene glycol (13) stearyl ether (steareth-13), polyethylene glycol (14) stearyl ether (steareth-14), polyethylene glycol (15) stearyl ether (steareth-15), polyethylene glycol (16) stearyl ether (steareth-16), polyethylene glycol (17) stearyl ether (steareth-17), polyethylene glycol (18) stearyl ether (steareth-18), polyethylene glycol (19) stearyl ether (steareth-19), polyethylene glycol (20) stearyl ether (steareth-20), polyethylene glycol (12) isostearyl ether (isosteareth-12), polyethylene glycol (13) isostearyl ether (isosteareth-13), polyethylene glycol (14) isostearyl ether (isosteareth-14), polyethylene glycol (15) isostearyl ether (isosteareth-15), polyethylene glycol (16) isostearyl ether (isosteareth-16), polyethylene glycol (17) isostearyl ether (isosteareth-17), polyethylene glycol (18) isostearyl ether (isosteareth-18), polyethylene glycol (19) isostearyl ether (isosteareth-19), polyethylene glycol (20) isostearyl ether (isosteareth-20), polyethylene glycol (13) cetyl ether (ceteth-13), polyethylene glycol (14) cetyl ether (ceteth-14), polyethylene glycol (15) cetyl ether (ceteth-15), polyethylene glycol (16) cetyl ether (ceteth-16), polyethylene glycol (17) cetyl ether (ceteth-17), polyethylene glycol (18) cetyl ether (ceteth-18), polyethylene glycol (19) cetyl ether (ceteth-19), polyethylene glycol (20) cetyl ether

(ceteth-20), polyethylene glycol (13) isocetyl ether (isoceteth-13), polyethylene glycol (14) isocetyl ether (isoceteth-14), polyethylene glycol (15) isocetyl ether (isoceteth-15), polyethylene glycol (16) isocetyl ether (isoceteth-16), polyethylene glycol (17) isocetyl ether (isoceteth-17), polyethylene glycol (18) isocetyl ether (isoceteth-18), polyethylene glycol (19) isocetyl ether (isoceteth-19), polyethylene glycol (20) isocetyl ether (isoceteth-20), polyethylene glycol (12) oleyl ether (oleth-12), polyethylene glycol (13) oleyl ether (oleth-13), polyethylene glycol (14) oleyl ether (oleth-14), polyethylene glycol (15) oleyl ether (oleth-15), polyethylene glycol (12) lauryl ether (laureth-12), polyethylene glycol (12) isolauryl ether (isolaureth-12), polyethylene glycol (13) cetylstearyl ether (ceteareth-13), polyethylene glycol (14) cetylstearyl ether (ceteareth-14), polyethylene glycol (15) cetylstearyl ether (ceteareth-15), polyethylene glycol (16) cetylstearyl ether (ceteareth-16), polyethylene glycol (17) cetylstearyl ether (ceteareth-17), polyethylene glycol (18) cetylstearyl ether (ceteareth-18), polyethylene glycol (19) cetylstearyl ether (ceteareth-19), polyethylene glycol (20) cetylstearyl ether (ceteareth-20).

It is furthermore advantageous to select the fatty acid ethoxylates from the following group:

polyethylene glycol (20) stearate, polyethylene glycol (21) stearate, polyethylene glycol (22) stearate, polyethylene glycol (23) stearate, polyethylene glycol (24) stearate, polyethylene glycol (25) stearate, polyethylene glycol (12) isostearate, polyethylene glycol (13) isostearate, polyethylene glycol (14) isostearate, polyethylene glycol (15) isostearate, polyethylene glycol (16) isostearate, polyethylene glycol (17) isostearate, polyethylene glycol (18) isostearate, polyethylene glycol (19) isostearate, polyethylene glycol (20) isostearate, polyethylene glycol (21) isostearate, polyethylene glycol (22) isostearate, polyethylene glycol (23) isostearate, polyethylene glycol (24) isostearate, polyethylene glycol (25) isostearate, polyethylene glycol (12) oleate, polyethylene glycol (13) oleate, poly-

ethylene glycol (14) oleate, polyethylene glycol (15) oleate, polyethylene glycol (16) oleate, polyethylene glycol (17) oleate, polyethylene glycol (18) oleate, polyethylene glycol (19) oleate, polyethylene glycol (20) oleate.

The ethoxylated alkyl ether carboxylic acid or salt thereof used can advantageously be sodium laureth-11 carboxylate. An alkyl ether sulfate which can advantageously be used is sodium laureth-14 sulfate. An ethoxylated cholesterol derivative which can advantageously be used is polyethylene glycol (30) cholesteryl ether. Polyethylene glycol (25) soyasterol has also proven successful. Ethoxylated triglycerides which can advantageously be used are the polyethylene glycol (60) evening primrose glycerides.

It is furthermore advantageous to select the polyethylene glycol glycerol fatty acid esters from the group consisting of polyethylene glycol (20) glyceryl laurate, polyethylene glycol (21) glyceryl laurate, polyethylene glycol (22) glyceryl laurate, polyethylene glycol (23) glyceryl laurate, polyethylene glycol (6) glyceryl caprate/caprinate, polyethylene glycol (20) glyceryl oleate, polyethylene glycol (20) glyceryl isostearate, polyethylene glycol (18) glyceryl oleate/cocoate.

It is likewise favourable to select the sorbitan esters from the group consisting of polyethylene glycol (20) sorbitan monolaurate, polyethylene glycol (20) sorbitan monostearate, polyethylene glycol (20) sorbitan monoisostearate, polyethylene glycol (20) sorbitan monopalmitate, polyethylene glycol (20) sorbitan monooleate.

Optional W/O emulsifiers, but ones which may nevertheless be advantageous for the purposes of the invention are the following:

fatty alcohols having from 8 to 30 carbon atoms, monoglycerol esters of saturated and/or unsaturated, branched and/or unbranched alkanecarboxylic acids having a chain length of from 8 to 24 carbon atoms, in

particular 12-18 carbon atoms, diglycerol esters of saturated and/or unsaturated, branched and/or unbranched alkanecarboxylic acids having a chain length of from 8 to 24 carbon atoms, in particular 12-18 carbon atoms, monoglycerol ethers of saturated and/or unsaturated, branched and/or unbranched alcohols having a chain length of from 8 to 24 carbon atoms, in particular 12-18 carbon atoms, diglycerol ethers of saturated and/or unsaturated, branched and/or unbranched alcohols having a chain length of from 8 to 24 carbon atoms, in particular 12-18 carbon atoms, propylene glycol esters of saturated and/or unsaturated, branched and/or unbranched alkanecarboxylic acids having a chain length of from 8 to 24 carbon atoms, in particular 12-18 carbon atoms, and sorbitan esters of saturated and/or unsaturated, branched and/or unbranched alkanecarboxylic acids having a chain length of from 8 to 24 carbon atoms, in particular 12-18 carbon atoms.

Particularly advantageous W/O emulsifiers are glyceryl monostearate, glyceryl monoisostearate, glyceryl monomyristate, glyceryl monooleate, diglyceryl monostearate, diglyceryl monoisostearate, propylene glycol monostearate, propylene glycol monoisostearate, propylene glycol monocaprylate, propylene glycol monolaurate, sorbitan monoisostearate, sorbitan monolaurate, sorbitan monocaprylate, sorbitan monoisooleate, sucrose distearate, cetyl alcohol, stearyl alcohol, arachidyl alcohol, behenyl alcohol, isobehenyl alcohol, selachyl alcohol, chimyl alcohol, polyethylene glycol (2) stearyl ether (steareth-2), glyceryl monolaurate, glyceryl monocaprinate and glyceryl monocaprylate.

The preferred preparations according to the invention are particularly suitable for protecting human skin against ageing processes and against oxidative stress, i.e. against damage caused by free radicals, as are produced, for example, by solar irradiation, heat or other influences. In this connection, it is in the various administration forms usually used for this application. For example, it may, in particular, be in the form of a lotion or

emulsion, such as in the form of a cream or milk (O/W, W/O, O/W/O, W/O/W), in the form of oily-alcoholic, oily-aqueous or aqueous-alcoholic gels or solutions, in the form of solid sticks or may be formulated as an aerosol.

The preparation may comprise cosmetic adjuvants which are usually used in this type of preparation, such as, for example, thickeners, softeners, moisturisers, surface-active agents, emulsifiers, preservatives, antifoams, perfumes, waxes, lanolin, propellants, dyes and/or pigments which colour the composition itself or the skin, and other ingredients usually used in cosmetics.

The dispersant or solubiliser used can be an oil, wax or other fatty substance, a lower monoalcohol or lower polyol or mixtures thereof. Particularly preferred monoalcohols or polyols include ethanol, isopropanol, propylene glycol, glycerol and sorbitol.

A preferred embodiment of the invention is an emulsion in the form of a protective cream or milk which, apart from the compound(s) of the formula I, comprises, for example, fatty alcohols, fatty acids, fatty acid esters, in particular triglycerides of fatty acids, lanolin, natural and synthetic oils or waxes and emulsifiers in the presence of water.

Further preferred embodiments are oily lotions based on natural or synthetic oils and waxes, lanolin, fatty acid esters, in particular triglycerides of fatty acids, or oily-alcoholic lotions based on a lower alcohol, such as ethanol, or a glycerol, such as propylene glycol, and/or a polyol, such as glycerol, and oils, waxes and fatty acid esters, such as triglycerides of fatty acids.

The preparation according to the invention may also be in the form of an alcoholic gel which comprises one or more lower alcohols or polyols, such

as ethanol, propylene glycol or glycerol, and a thickener, such as siliceous earth. The oily-alcoholic gels also comprise natural or synthetic oil or wax.

The solid sticks consist of natural or synthetic waxes and oils, fatty alcohols, fatty acids, fatty acid esters, lanolin and other fatty substances.

If a preparation is formulated as an aerosol, the customary propellants, such as alkanes, fluoroalkanes and chlorofluoroalkanes, are generally used.

The cosmetic preparation may also be used to protect the hair against photochemical damage in order to prevent colour changes, bleaching or damage of a mechanical nature. In this case, a suitable formulation is in the form of a rinse-out shampoo, lotion, gel or emulsion, the preparation in question being applied before or after shampooing, before or after colouring or bleaching or before or after permanent waving. It is also possible to select a preparation in the form of a lotion or gel for styling or treating the hair, in the form of a lotion or gel for brushing or blow-waving, in the form of a hair lacquer, permanent waving composition, colorant or bleach for the hair. Besides the compounds of the formula I, the preparation having light-protection properties may comprise various adjuvants used in this type of composition, such as surfactants, thickeners, polymers, softeners, preservatives, foam stabilisers, electrolytes, organic solvents, silicone derivatives, oils, waxes, antigrease agents, dyes and/or pigments which colour the composition itself or the hair, or other ingredients usually used for hair care.

The entire disclosure of all applications, patents and publications, cited above are hereby incorporated by reference.

The pigments and their production process according to the present invention is more illustratively demonstrated but not limited by means of the following examples.

Examples:

L, a and b measurement:

The L, a and b values of the employed inorganic pigments and the antimicrobial pigments have been measured with a Phyma WICO 5&5 and a Minolta CR300 measurement system.

Example 1:

Ronaspheres® treated with Ag_2O

30 g Ronaspheres® (D_{50} 2.5-3.5µm, silica) are homogenised with 0.02% Ag_2O by weight, based on the Ronaspheres®. Then 31 ml of distilled water are added to the mixture that is then stirred for 16 h. The reaction temperature is held at 37°C. The initial dark colour of the reaction mixture turns to colourless at the end of the reaction indicating complete conversion of silver oxide. The suspension is filtered off and then washed several times with water and with acetone. The solvent is removed by evaporation and the pigments are then dried.

Visual comparison between the Ronaspheres® and the Ronaspheres® + 0.02% Ag_2O do not show any noticeable change in colour.

L,a,b powder measurements:

L, a and b values:

of the employed inorganic pigment:	L = 93.5;	a = -0.2;	b = +0.7
of the antimicrobial pigment:	L = 93.6;	a = -0.2;	b = +0.9

Example 2:

Timiron® pigments treated with Ag_2O:

5 g Timiron® Silk Gold (TiO_2 coated mica) are homogenised with 0.02% Ag_2O by weight, based on the pigments. Then 11 ml of distilled water are added to the mixture that is then stirred for 16 h. The reaction temperature was held at 37°C. The initial dark colour of the reaction mixture turns to the original colour of the pigment during the reaction indicating complete conversion of silver oxide. The suspension is sucked off, and then washed several times with water and with acetone. The solvent is removed by evaporation and the pigments are then dried.

Visual comparison between the colour card of Timiron® Silk Gold and the colour card with Timiron® Silk Gold + 0.02% Ag_2O do not show any noticeable change in colour.

L,a,b powder measurements:

L, a and b values:

of the employed inorganic pigment:	L = 88.3;	a = -2.6;	b = 10.5
of the antimicrobial pigment:	L = 88.3;	a = -2.5;	b = 10.6

Example 3:

Timiron® pigments treated with Ag_2O:

5 g Timiron® Starluster MP 115 (TiO_2 coated mica) are homogenised with 0.02% Ag_2O by weight, based on the pigments. Then 11 ml of distilled water are added to the mixture that is then stirred for 16 h. The reaction temperature was held at 37°C. The initial dark colour of the reaction mixture turns to the original colour of the pigment during the reaction

indicating complete conversion of silver oxide. The suspension is sucked off, and then washed several times with water and with acetone. The solvent is removed by evaporation and the pigments are then dried.

Visual comparison between the colour card of Timiron® Starluster MP 115 and the colour card with Timiron® Starluster MP 115 + 0.02% Ag_2O do not show any noticeable change in colour.

L,a,b powder measurements:

L, a and b values of the employed inorganic pigment and the antimicrobial pigment (example 3):

of the employed inorganic pigment: L = 88.4; a = +0,4; b = +3,6

of the antimicrobial pigment: L = 88.3; a = +0,4; b = +3,7

Example 4-5:

Creams (O/W) with antimicrobial Ronaspheres® (Example 1):

Example Raw material	Manufacturer	4 [%]	5 [%]
A			
Ronasphere®+0.02% Ag_2O	(1)	5.00	1.00
Veegum HV	(2)	1.00	1.00
Karion F liquid	(1)	3.00	3.00
Water, deionised		57.00	61.00
B			
Arlacel 165 VP	(3)	5.00	5.00
Lanette O	(4)	1.50	1.50
Miglyol 812 N	(5)	7.00	7.00
Sheabutter solid	(6)	2.00	2.00
Cetiol SN	(4)	7.00	7.00
Eutanol G	(4)	7.50	7.50
Emulgade PL 68/50	(4)	2.00	2.00
C			
Dow Corning 345	(7)	2.00	2.00
Total		100.00	100.00

Manufacturers:

(1) Merck KGaA/Rona®

(2) Vanderbilt

(3) Uniqema

(4) Cognis GmbH

5) Sasol Germany GmbH

(6) H. Erhard Wagner GmbH

(7) Dow Corning

Preparation:

Veegum is dispersed in the water of phase A, adding resting raw materials and heating to 80°C. Adding phase B heated to 80°C into phase A, followed by homogenising. During cooling to 40°C the mixture is stirred. Afterwards phase C is added and the resulting mixture is cooled to room temperature and adjusted to pH 6.0.

Examples 6-7:

Lotions with antimicrobial Timiron® Starluster (Example 3)

Example Raw material	Manufacturer	6 [%]	7 [%]
A			
Timiron® Starluster + 0.02% Ag_2O	(1)	5.00	1.00
Carbopol ETD 2001	(2)	0.60	0.60
Water, deionised		38.30	42.30
B			
RonaCare® Allantoin	(1)	0.20	0.20
Water, deionised		31.00	31.00
C			
Hostaphat KL 340 D	(3)	3.00	3.00
Cetylalkohol	(1)	2.00	2.00
Paraffine liquid	(1)	10.05	10.05

Cetiol V	(4)	6.00	6.00
D			
Triethanolamine	(1)	0.35	0.35
Water, deionised		3.50	3.50
Total		100.00	100.00

Manufacturers:

(1) Merck KGaA/Rona®

(2) Noveon

(3) Clariant GmbH

(4) Cognis GmbH

Preparation:

The pigment is dispersed in water of phase A. To lower the viscosity, citric acid can be added. Afterwards Carbopol is added. After complete solution the phase B is slowly added. Phase A/B and C are heated up to 80°C and phase C is stirred into phase A/B and homogenised. Then the mixture is neutralised and homogenised with phase D. The mixture is cooled down during continuous stirring.

Examples 8-9:

Creams with antimicrobial Timiron® Silk Gold (Example 2)

Example		8	9
Raw material	**Manufacturer**	**[%]**	**[%]**
A			
Timiron® Silk Gold + 0.02% Ag_2O	(1)	5.00	1.00
Carbopol ETD 2001	(2)	0.60	0.60
Water, deionised		38.30	42.30
B			
RonaCare® Allantoin	(1)	0.20	0.20
Water, deionised		31.00	31.00
C			

Hostaphat KL 340 D	(3)	3.00	3.00
Cetylalkohol	(1)	2.00	2.00
Paraffin flüssig	(1)	10.05	10.05
Cetiol V	(4)	6.00	6.00
D			
Triethanolamin	(1)	0.35	0.35
Water, deionised		3.5	3.5
Total		100.00	100.00

Manufacturers:

(1) Merck KGaA/Rona®

(2) Noveon

(3) Clariant GmbH

(4) Cognis GmbH

Preparation:

The pigment is dispersed in water of phase A. To lower the viscosity, citric acid can be added. Afterwards Carbopol is added with stirring. After complete solution the phase B is slowly added. Phase A/B and C are heated up to 80°C and phase C is stirred into phase A/B and homogenised. Then the mixture is neutralised and homogenised with phase D. The mixture is cooled down during continuous stirring.

Example 10:

Deodorant Lotion with antimicrobial Ronaspheres® (Example 1):

Raw material	Manufacturer	[%]
A		
Glyceryl Stearate (and) Ceteth-20	(1)	3.1
Cetearyl Octanoate	(1)	3.1
Caprylic/Capric Triglyceride	(1)	3.1
Stearyl Alcohol	(1)	1.1
Dimethicone	(1)	0.5

B	
Glycerin	3.0
Aqua	84.95
Ronasphere® + 0.02% Ag_2O	1
C	
Citric Acid	0.15

Manufacturers:

(1) Goldschmidt

Preparation:

Phase A and phase B are separately heated to 80°C. The phases are combined without stirring, thus avoiding the formation of an O/W emulsion. The mixture is homogenised and cooled down to 30°C during stirring. Phase C is added at temperatures below 40°C.

Example 11:

Deo-Roll-On with antimicrobial Timiron® Silk Gold (Example 2):

Raw material	Manufacturer	%
A		
Hydroxypropyl Methylcellulose	(1)	1.2
Aqua		86.4
B		
Timiron® Silk Gold + 0.02% Ag_2O		0.5
Glycolic Acid	(2)	0.04
Aqua		9.86
Glycerin		2.0

Manufacturers:

(1) Dow Corning

(2) Merck KGaA

Preparation:

The cellulose is slowly added to water during continuous stirring until a transparent and viscous swelling is obtained. Phase B is added to phase A and homogenously stirred.

Anti-microbial investigations:

A standard procedure to measure the anti-microbial activity of substances was used (challenge tests). A suspension of test organisms (10^5 to 10^6 germs/ml) is inoculated into a recipient containing already the substance to be tested. Samples of the inoculated suspension are taken and the number of germs is measured thanks to the Agar plates method. Germ counts is performed at t = 0, t = 24h after the inoculation, t = 48 h after the inoculation, t = 7 days after the inoculation, t = 14 days after the inoculation.

Sterile water containing 8% w/w of treated and untreated carriers were each investigated.

Ronaspheres® of Example 1 in an 8% aqueous suspension

	Germs Number/ml after					
Organism	**Inoculum**	**Start**	**24h**	**48h**	**7d**	**14d**
Bacteria						
Escheria coli ATCC8739	$3.1 \cdot 10^6$	$3.6 \cdot 10^6$	0	0	0	0
Pseudomonas	$8.5 \cdot 10^5$	$8.4 \cdot 10^5$	0	0	0	0

aeruginosa ATCC 9027						
Staphylococcus aureus ATCC 6538	$3.7 \cdot 10^6$	$1.87 \cdot 10^6$	0	0	0	0
Yeast and Fungi						
Candida albicans ATCC 10231	$7.8 \cdot 10^5$	$7.1 \cdot 10^5$	$1.4 \cdot 10^2$	0	0	0
Aspergillus niger ATCC 16404	$5.0 \cdot 10^5$	$3.9 \cdot 10^5$	$1.3 \cdot 10^5$	0	0	0

Blind value: 0,02% Ag_2O in an 8% aqueous suspension

	Germs Number /ml after					
Organism	Inoculum	Start	24h	48h	7d	14d
Bacteria						
Escheria coli ATCC8739	$3.1 \cdot 10^6$	$2.0 \cdot 10^6$	0	0	0	0
Pseudomonas aeruginosa ATCC 9027	$8.5 \cdot 10^5$	$2.2 \cdot 10^5$	0	0	0	0
Staphylococcus aureus ATCC 6538	$3.7 \cdot 10^6$	$2.7 \cdot 10^6$	0	0		0
Yeast and Fungi						
Candida albicans ATCC 10231	$7.8 \cdot 10^5$	$9.0 \cdot 10^2$	$8.3 \cdot 10^2$	0	0	0
Aspergillus niger ATCC 16404	$5,0 \cdot 10^5$	$4.5 \cdot 10^5$	$3.5 \cdot 10^5$	$1.6 \cdot 10^5$	$1.0 \cdot 10^5$	$2.2 \cdot 10^4$

Ronaspheres® Blind value in an 8% aqueous suspension

Ronaspheres® alone do not show any significant anti-microbial activity.

	Germs Number /ml after				
Organism	**Inoculum**	**Start**	**24h**	**4d**	**7d**
Bacteria					
Escheria coli ATCC8739	$3.2 \cdot 10^6$	$3.2 \cdot 10^6$	$3.8 \cdot 10^6$	$3.2 \cdot 10^6$	$6.9 \cdot 10^5$
Pseudomonas aeruginosa ATCC 9027	$1.7 \cdot 10^6$	$1.4 \cdot 10^6$	$2.1 \cdot 10^6$	$1.1 \cdot 10^6$	$8.9 \cdot 10^5$
Staphylococcus aureus ATCC 6538	$2.0 \cdot 10^6$	$9.8 \cdot 10^5$	$3.8 \cdot 10^6$	$3.3 \cdot 10^5$	$6.9 \cdot 10^4$
Yeast and Fungi					
Candida albicans ATCC 10231	$9.2 \cdot 10^5$	$7.2 \cdot 10^5$	$8.2 \cdot 10^5$	$8.0 \cdot 10^5$	$8.9 \cdot 10^5$
Aspergillus niger ATCC 16404	$3.8 \cdot 10^5$	$8.3 \cdot 10^5$	$2.5 \cdot 10^5$	$3.8 \cdot 10^5$	$1.2 \cdot 10^5$

Antimicrobial Timiron® Starluster (Example 3) in an 8% aqueous suspension

7 days after the inoculation the whole amount of microorganisms were killed.

Timiron® Starluster (Blind value) in an 8% aqueous suspension

The pigment alone does not show any bactericide or fungicide activity.

Antimicrobial Timiron® Silk Gold (Example 2) in an 8% aqueous suspension:

7 days after the inoculation the whole amount of microorganisms were killed.

Timiron® Silk Gold (Blind value) in an 8% aqueous suspension

The pigment alone does not show any bactericide or fungicide activity.

Timiron® Silk Gold + 0.01% Ag_2O (preparation procedure similar to example 2) in a 8% aqueous suspension

	Germs Number /ml after					
Organism	**Inoculum**	**Start**	**24h**	**4d**	**7d**	**14d**
Bacteria						
Escheria coli ATCC8739	$2.1 \cdot 10^6$	$3.9 \cdot 10^5$	0	0	0	0
Pseudomonas aeruginosa ATCC 9027	$1.6 \cdot 10^6$	$3.2 \cdot 10^5$	0	0	0	0
Staphylococcus aureus ATCC 6538	$1.2 \cdot 10^6$	$1.3 \cdot 10^6$	$1,3 \cdot 10^3$	0	0	0
Yeast and Fungi						
Candida albicans ATCC 10231	$8.6 \cdot 10^5$	$1.0 \cdot 10^5$	0	0	0	0
Aspergillus niger ATCC 16404	$3.8 \cdot 10^5$	$1.9 \cdot 10^5$	$5.8 \cdot 10^4$	$3.3 \cdot 10^4$	$6.9 \cdot 10^3$	$1.4 \cdot 10^3$

Timiron® Starluster + 0,01% Ag_2O (preparation procedure similar to example 3) in a 8% aqueous suspension

	Germs Number /ml after					
Organism	**Inoculum**	**Start**	**24h**	**4d**	**7d**	**14d**
Bacteria						
Escheria coli	$2.1 \cdot 10^6$	$5.4 \cdot 10^5$	$1.5 \cdot 10^3$	0	0	0

ATCC8739						
Pseudomonas aeruginosa ATCC 9027	$1.6 \cdot 10^6$	$7.1 \cdot 10^5$	0	0	0	0
Staphylococcus aureus ATCC 6538	$1.2 \cdot 10^6$	$1.7 \cdot 10^6$	$1.7 \cdot 10^4$	0	0	0
Yeast and Fungi						
Candida albicans ATCC 10231	$8.6 \cdot 10^5$	$3.2 \cdot 10^5$	$1.4 \cdot 10^2$	0	0	0
Aspergillus niger ATCC 16404	$3.8 \cdot 10^5$	$2.5 \cdot 10^5$	$9.5 \cdot 10^4$	$6.5 \cdot 10^4$	$1.4 \cdot 10^4$	$3.7 \cdot 10^3$

Determination of the bacteriostatic activity of the antimocrobial pigments (Minimal inhibitory concentrations (MIC)):

The MICs were determined using an agar dilution method based on DIN 58940 and 58944. Petri dishes of 8.5 cm diameter were poured with 9 ml of freshly prepared Mueller-Hinton agar (Merck Company) or Wilkins-Chalgren agar (Oxoid, supplemented with 10 g Agar-agar per liter) maintained in liquid form at 50°C, to which the sample dilutions at various concentrations had been added at 25%. To prepare the sample dilutions, a 24.3% solution of the solid sample material was prepared with Aqua bidest. Progressive 1:2 dilutions of this solution were made with Aqua bidest to prepare further test concentrations that were set up in the form of geometric series. 4-fold lower final concentrations were reached by additional dilution with the test agar. Two agar plates were poured for each test concentration and culture medium.

After solidification and drying, the test plates were inoculated with 1 µl drops of the test microbe suspensions. The agar plates were incubated and subsequently evaluated. The MIC was given as the lowest concentration of the active substance at which there was no macroscopically visible growth.

The results are shown in the folloing tables:

Acne application	**MICs in water and in% for:**		
Pigments / **Germs**	**Talc Low Coat/ 0.03% Ag_2O**	**Micronaspheres/ 0.02% Ag_2O**	**Mica Low Coat/0.07% Ag_2O**
Propionibacterium acnes	4.05	4.05	0.76
Staphylococcus epidermidis	4.05	2.03	1.52
Deodorant Application			
Corynebacterium xerosis	8.1	2.03	1.52
Staphylococcus aureus	8.1	4.05	3.04
Staphylococcus epidermidis	4.05	2.03	1.52

Dandruff	**MICs in water and in% for:**	
Pigments / **Germs**	**MP 115/0.02 % Ag_2O**	**MP 1001/0.07 % Ag_2O**
Malazessia furfur	**4.05**	**1.0**